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REPORT

OF THE

TESTS OF METALS

AND OTHER MATERIALS

FOR

INDUSTRIAL PURPOSES

MADE WITH THE

UNITED STATES TESTING MACHINE AT WATERTOWN ARSENAL, MASSACHUSETTS, DURING THE FISCAL YEAR ENDED JUNE 30,

1906.

WASHINGTON:
GOVERNMENT PRINTING OFFICE
1907.

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WAR DEPARTMENT,
Washington, February 13, 1907.

SIR: I have the honor to transmit herewith a letter from the Chief of Ordnance, U. S. Army, dated 12th instant, submitting, for transmission to Congress as required by law, copy of the report of the commanding officer of Watertown Arsenal, of "Tests of iron and steel and other material for industrial purposes," made at that arsenal during the fiscal year ended June 30, 1906.

Very respectfully,

WM. H. TAFT,
Secretary of War.

The SPEAKER OF THE HOUSE OF REPRESENTATIVES.

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF ORDNANCE,
Washington, February 12, 1907.

SIR: I have the honor to submit, for transmission to Congress as required by law, a copy of the report of the commanding officer of Watertown Arsenal, of "Tests of iron and steel and other material for industrial purposes," made at that arsenal during the fiscal year ended June 30, 1906. (O. O. file 18563.)

Respectfully,

WILLIAM CROZIER,
Brig. Gen., Chief of Ordnance.

The SECRETARY OF WAR.

WATERTOWN ARSENAL,
Watertown, Mass., October 24, 1906.

SIR: I have the honor to submit herewith the annual report of tests of iron and steel and other materials made at this arsenal during the fiscal year ended June 30, 1906.

The total number of specimens tested during the year was classified as follows:

Gun specimens	50
For Ordnance Department	1,531
For other Government Departments	180
Investigative tests	514
Tests for private parties	951
Total	3,226

The receipts and expenditures were as follows:

Amount appropriated for testing machine and testing work	$15,000.00
Received from private parties	1,087.11
Total received	16,087.11
Amount expended for services and labor	11,197.35
Amount expended for light, power, tools, implements, and materials for tests	4,889.67
Deposited to credit of Treasurer of United States	.09
Total	16,087.11

Among the tests of an investigative character, conducted during the past fiscal year, are the results of an examination of the metal of a fluid-compressed ingot of nickel steel, which was treated by the Harmet process. The weight of this ingot was about 17 tons. It was cast in the Oberbilker Steel Works, Düsseldorf, Germany, and represents a process of fluid compression in which the metal is forced from the larger toward the smaller end of a tapering mold, thereby subjecting the walls to radial compression, and causing a certain amount of extension in length incident to the change in cross-section dimensions.

In the examination of the ingot it was first cut apart transversely at the middle of its length, then each half was split longitudinally, the cut in the lower half being taken at right angles with that of the upper half. Specimen slabs, longitudinal and transverse, were taken from the parts exposed by the cuts above described. The surface of the slabs thus exposed showed a columnar structure present, normal or nearly so to the surface of the ingot at the top and bottom, and making an average angle with the sides of about 74°, the trend being upward, toward the smaller end of the ingot. There were short lines or streaks parallel to the columnar structure present in different parts of the ingot, where the structural continuity of the metal was impaired.

Tensile specimens were taken out of the slices, parallel and perpendicular to the sides of the ingot, and also parallel and perpendicular

to the columnar structure. The comparatively low strength and the fissured appearance of test pieces taken crosswise the structure showed the streaks to be lines of weakness. These lines of weakness were not confined to any particular part of the ingot. There was no central pipe nor open cavities shown by the ingot, the structural unsoundness, where it existed, being manifested by the presence of short lines or streaks, at which places the metal was deficient in strength and structural continuity.

The metal in the natural state of the ingot was tested, and also specimens which had been annealed. A modification of the tensile properties in the sound metal resulted from the process of annealing without, however, effacing the influence of structural defects.

Forged and annealed specimens, tested in the direction in which they had been worked, did not show the ingot unsoundness.

Tests have been continued with concrete and mortar columns, both plain and reënforced. Reënforcing material has been contributed by the Clinton Wire Cloth Company, the Cummings Structural Concrete Company, the Expanded Metal Companies, the Hennebique Construction Company, and the Trussed Concrete Steel Company. The tests include a wide range in the composition of the concretes and mortars, and embrace types of reënforcement in which longitudinal steel bars are used, and by means of hooping or other external lateral support. Columns have been prepared to ascertain the endurance of concrete for long-continued loads. The loads will be maintained by means of tension rods and end plates.

Some carbon steel rails were contributed for test by Mr. C. S. Sergeant, vice-president Boston Elevated Railway Company, and a section of cast manganese steel rail by Messrs. Harrington, Robinson & Co., the latter representing metal in use in the tracks of the Boston Elevated Railway Company, which has displayed phenomenal resistance against abrasion and wear.

In this volume are a number of photographs illustrating the equipment of the testing laboratory. The testing machines are shown and the principal accessory apparatus illustrated.

Acknowledgment is due Mr. J. E. Howard, C. E., for the scope of the investigative tests, and for having conducted the operations of the laboratory so satisfactorily.

An increase in the appropriation for the testing laboratory is recommended. It is recognized that questions of importance pertaining to the physical properties of constructive materials for industrial purposes are in need of additional data. The resources of the laboratory are adequate for the early development of such information in greater volume than heretofore, provided funds were available for operating the several machines to their full capacity.

Very respectfully, your obedient servant,

F. E. HOBBS,
Major, Ordnance Department, U. S. Army, Commanding.

The CHIEF OF ORDNANCE, U. S. ARMY,
Washington, D. C.

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REPORT

OF THE

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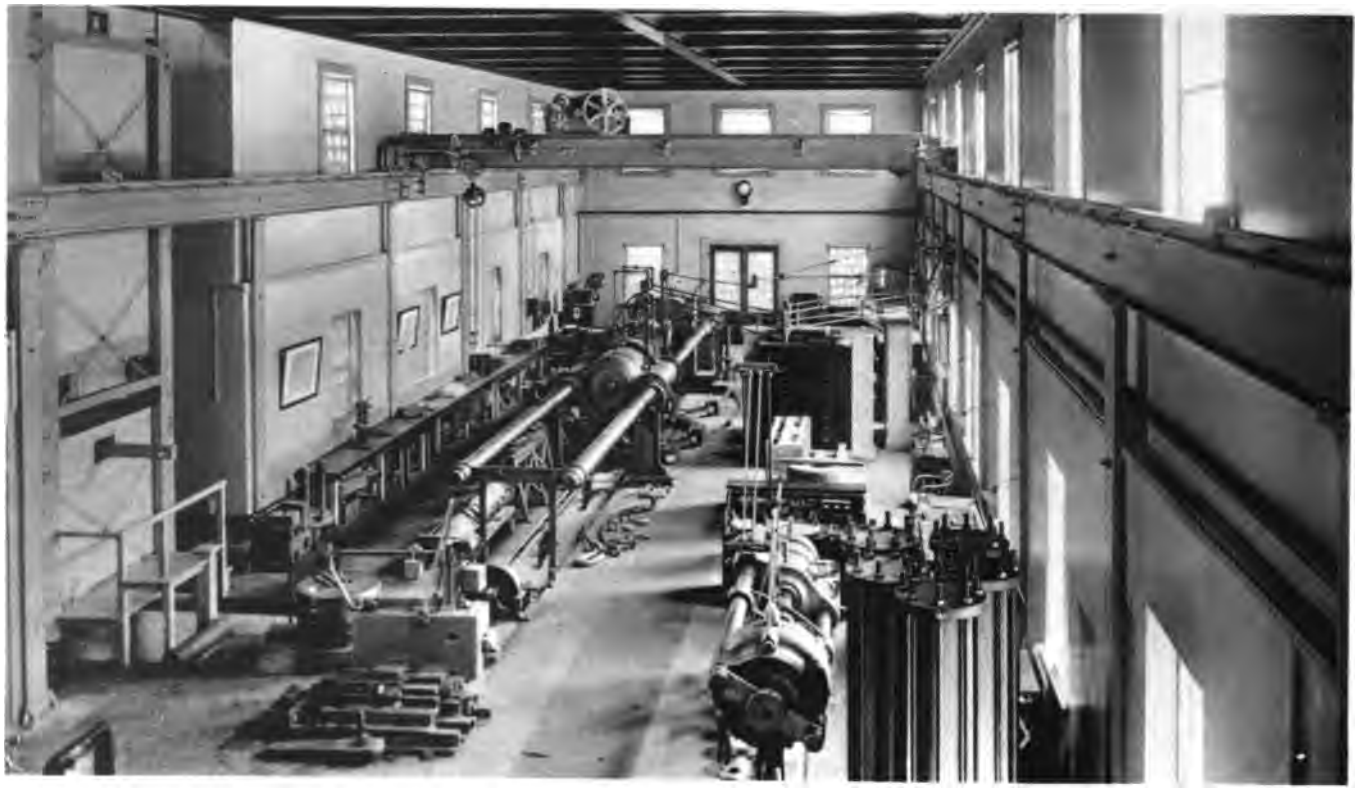
1906.

EQUIPMENT OF THE WATERTOWN ARSENAL TESTING LABORATORY.

EQUIPMENT OF THE WATERTOWN ARSENAL TESTING LABORATORY.

Number of plate.	Apparatus.
1, 2, 3	800,000 pounds testing machine.
4	100,000 pounds testing machine.
5	Impact machine.
6	Repeated stress machine.
7	Ball-bearing machine.
8, 9	Comparator.
10	Test levers.
11, 12, 13	Extensometers.
14	Inclinometer.
15, 16, 17	Micrometer for interior diameters.
18	Micrometer for exterior diameters.
19	Multiple laying-off punches.
20	Vernier for elongations.
	High-speed steam turbine.
	Cement briquette machine.
	Pyrometers.
	Microscopic and polishing outfit.
	Chemical laboratory.
	Machine tools.



NO. 1.

GENERAL VIEW OF MAIN ROOM OF WATERTOWN ARSENAL TESTING LABORATORY.

CAMPBELL ART CO.
ELIZABETH, N. J.

DESCRIPTION OF APPARATUS.

Plate No. 1 is a view of the main room of the testing laboratory. It shows the 800,000 pounds Emery testing machine, the 100,000 pounds Emery testing machine, the accumulator weights— three on the left of the cut, the test levers of 50,000 pounds capacity, a cement briquette-testing machine of 1,000 pounds capacity, and an electric crane of 5 tons capacity. Power for driving the geared parts of the 800,000 pounds testing machine, the repeated-stress machine, the ball-bearing machine, and the machine tools is furnished by a high-speed Atlas steam engine of 18 horsepower. Hydraulic power for the accumulator is supplied by a Knowles steam pump, having a steam cylinder 10 inches diameter by 12-inch stroke, a low-pressure hydraulic piston 1½ inches in diameter, and high-pressure hydraulic piston seven-eighths of an inch diameter. The engine and pump are located in a room at the side of and beyond the end of the main room, the movements of the pump being controlled from a point in the main room as well as at the pump itself. The engine room also contains a Dean air compressor, the steam end of which is 8 inches diameter by 12-inch stroke. The air end is 10 inches diameter.

Plate No. 2 shows the 800,000 pounds Emery testing machine, designed and built by Mr. A. H. Emery. This machine is adapted for applying loads of tension and of compression, and also transverse stresses, to beams of short span. It is adjusted in position for the test of members of different lengths by means of nuts on the main screws actuated by gearing. Hydraulic power is used during testing. The principal dimensions are as follows:

Diameter of straining cylinder	inches..	20
Diameter of piston rod	do...	10
Stroke of piston	do...	24
Main screws, diameter	do...	8.5
Main screws, length	feet..	48
Main screws, distance from center to center	inches..	50
Height, center line of machine from floor	do...	47
Hydraulic pulling heads:		
Openings of jaws—		
Width	inches..	30
Height	do...	6
Depth	do...	16
Middle part of same—		
Width	do...	15
Height	do...	10
Depth	do...	16

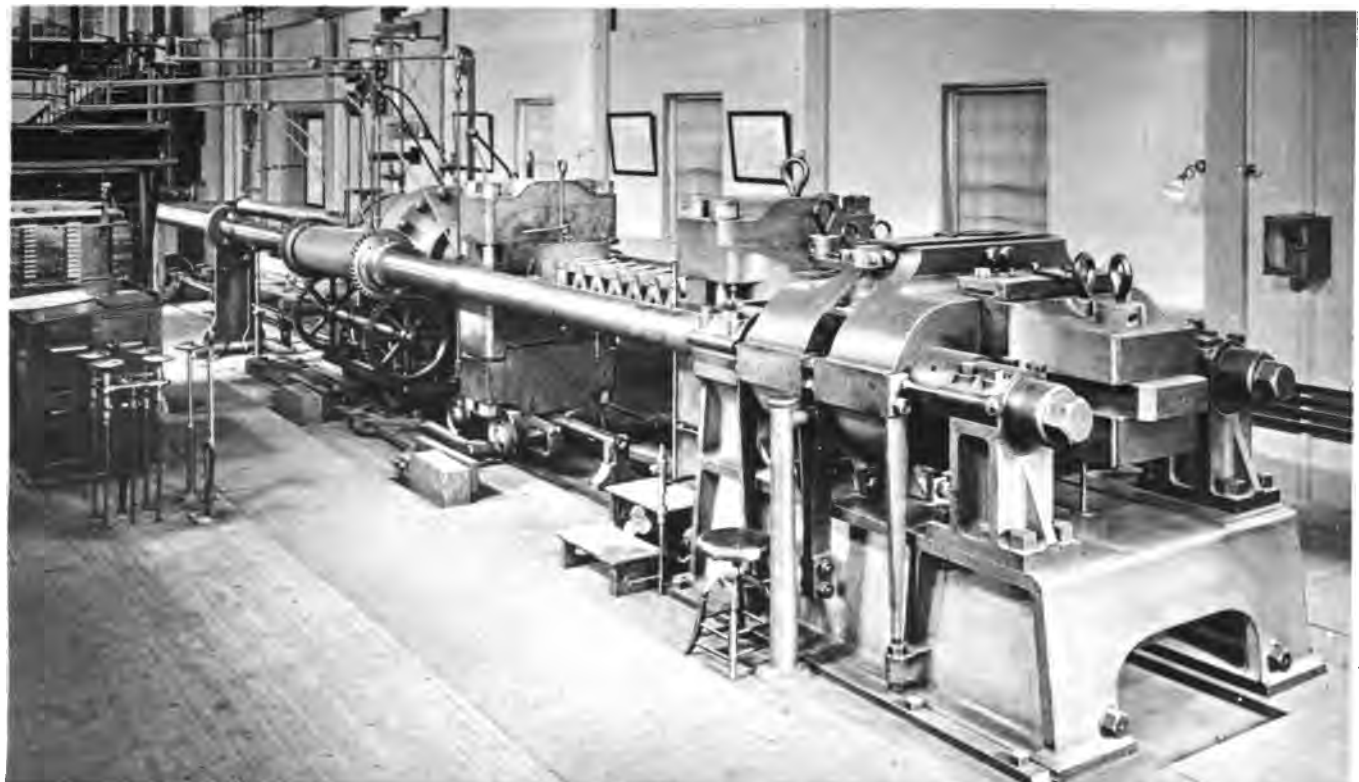
The jaws have a movement of 1 inch. Interior plates or liners reduce the openings to the size of the specimens or auxiliary fixtures. The maximum gripping force which may be applied is 1,000,000 pounds.

There are auxiliary holders for tension specimens, one set having a capacity of 50,000 pounds and another set for loads up to 600,000 pounds. These holders are provided with ball-and-socket seats to insure alignment and an axial pull of the test pieces. Platforms for compression tests are held in position by the jaws of the pulling heads. The stationary compression platform has a face 18 by 18 inches. The opposite platform has a ball-and-socket seat and presents a face 19.75 by 19.75 inches. Supplementary platforms 2.34 inches diameter, with hardened faces, may be attached to the main platforms for accessibility in the test of small-sized specimens.

When the testing machine is extended the maximum distance from face to face of the pulling heads is 27 feet 5¾ inches. With the compression platforms in place the maximum distance from face to face is 26 feet 3¼ inches.

The accumulator used with the testing machines has three weights averaging about 26,300 pounds each, carried by rams of 5½ inches and 10 inches diameter, one ram working within the other. The several accumulator pressures are as follows:

	Pounds per square inch.
10-inch ram with one weight	354
10-inch ram with two weights	676
10-inch ram with three weights	1,007
5½-inch ram with one weight	1,205
5½-inch ram with two weights	2,296
5½-inch ram with three weights	3,329



NO. 2.

800,000-POUNDS EVERY TESTING MACHINE.

CAMPBELL ART CO.
ELIZABETH, N. J.

The maximum piston speeds of the testing machine which results from the use of these pressures have been observed as follows:

	Inches per minute.
10-inch ram with one weight	2.65
10-inch ram with two weights	4.20
10-inch ram with three weights	5.50
5½-inch ram with one weight	6.20
5½-inch ram with two weights	8.40
5½-inch ram with three weights	11.00

The movement for adjustment of position, using the gear drive, is 12 inches per minute. The above-mentioned piston movements are approximate, but are those which may be realized when the machine has no specimen in place.

In regard to the minimum rate of speed, a piston movement of less than 0.01 inch per minute admits of control. Intermittent movements may be given the piston, and specimens strained small distances at will, measured by ten-thousandths of an inch.

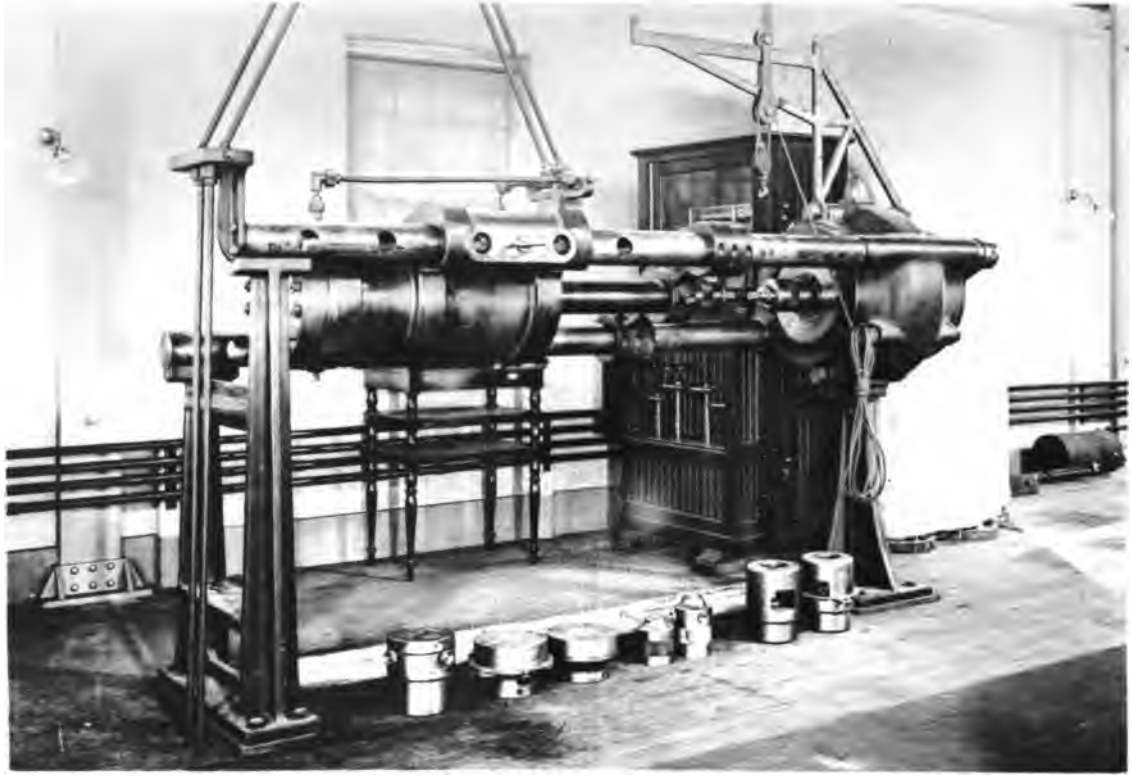
Plate No. 3 shows the weighing scale and gauges of the 800,000 pounds machine, also the valves for the accumulator piping and pump, and the lever for controlling the geared parts of the machine. The weighing apparatus has four hydraulic supports located between the two platforms of the machine, which platforms are shown on plate No. 2. These supports of larger diameter are connected with four of smaller diameter located in the bottom part of the scale case, the transmission of power from one set of supports to the other being accomplished by means of copper tubing, the diameter of the bore of which is 0.07 inch. Multiplying levers mounted upon steel fulcrum plates receive the load from the smaller set of hydraulic supports, and with the poise and sliding weights go to make up the weighing mechanism. There are four sets of poise weights of ten to each set. Each weight of the first set represents 100 pounds on the specimens, those of the second set 1,000 pounds, of the third set 10,000 pounds each, and of the fourth set 100,000 pounds each. The actual weight of each of the fourth set is about 10.56 pounds. The poise weights are lowered in succession, by means of hand levers, upon rods suspended from the main scale beam. Shoulders at regular intervals on the suspended rods receive the poise weights when thus lowered. A sliding weight is used for loads below 100 pounds, its beam being graduated to single pounds, the limit of sensitiveness of the weighing apparatus. The control of a test is at the scale case, where, in addition to the poise weight levers, there are valves which apply and regulate the hydraulic pressure from the accumulator as it is admitted to the straining cylinder of the machine.

The two gauges in the case on the left of the plate are connected with the tension and compression sides of the piston of the straining cylinder, respectively. They indicate the loads which are applied at one end of the machine, the reading of the scale beam indicating the load which has been transmitted through the test piece to the weighing apparatus at the other end of the machine. The gauges read higher than the weighing apparatus by the amount of packing friction of the piston and the tractive resistance of the movable pulling head. The gauges in the middle case of the plate are connected with the hydraulic jaws of the pulling heads, the lower pressure gauge of the two indicating gripping loads up to 345,000 pounds, the higher pressure gauge indicating loads up to 1,000,000 pounds.

NO. 3.

SCALE AND GAUGE CASES OF 800,000-POUNDS EMERY TESTING MACHINE.

CAMPBELL ART CO.
ELIZABETH N. J.



NO. 4.

100,000-POUNDS EMERY TESTING MACHINE.

CAMPBELL ART CO.
ELIZABETH N. J.

Plate No. 4 shows the 100,000 pounds Emery testing machine, built by Wm. Sellers & Co. This also is adapted for applying loads of tension and compression and transverse stresses to beams of short span. It is adjusted in position for the test of specimens of different lengths along the side rods, where it may be retained in a number of places by means of pins. The principal dimensions are:

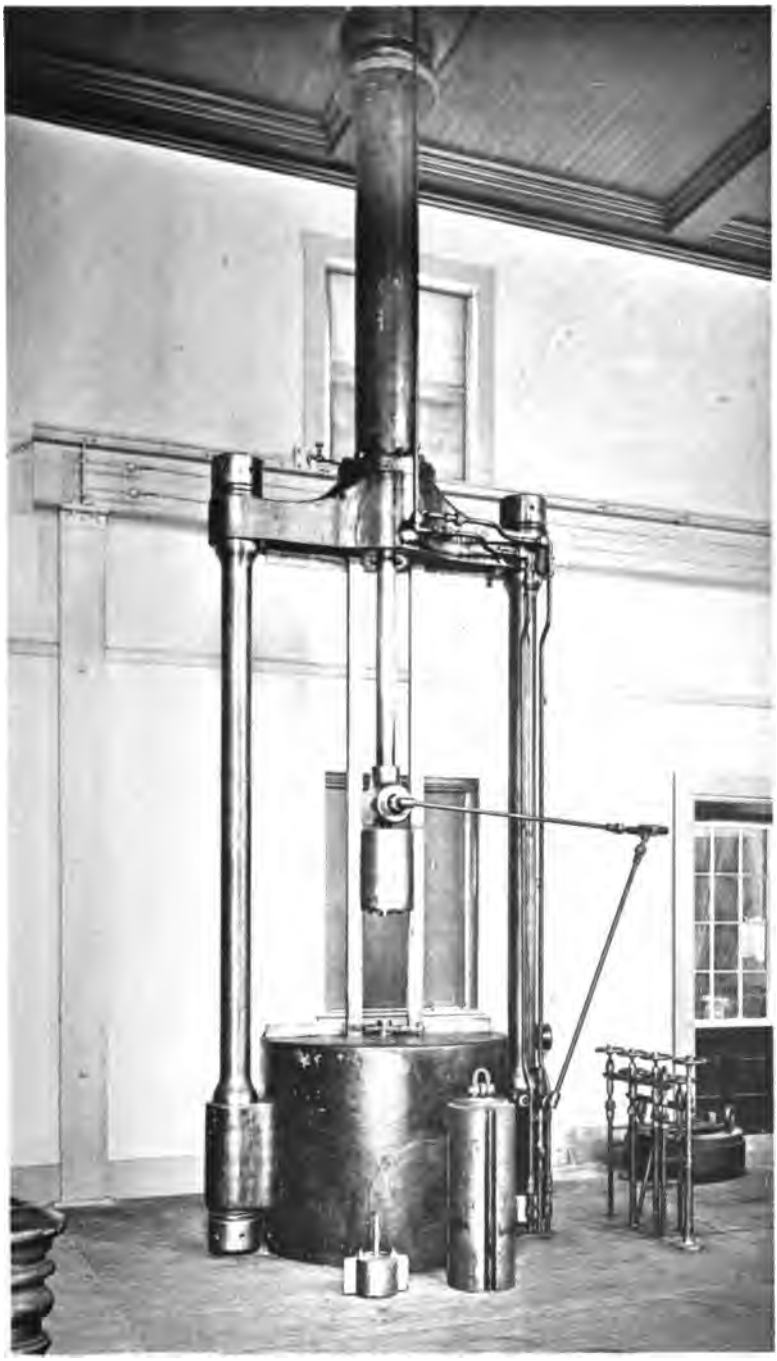
	Inches.
Diameter of straining cylinder	12.5
Diameter of piston rod	5.18
Stroke of piston	24
Side rods, diameter	5
Height, center line of machine from floor	50
Front side rod, axis below center line of machine	6.75
Rear side rod, axis above center line of machine	6.75

Tension holders for specimens with threaded ends are provided in sizes ranging from 0.50 inch diameter to 1.5 inches diameter. These fixtures have ball-and-socket seats. Tension holders with wedge jaws receive specimens up to 3 inches wide by 1 inch thick for flats, and up to 1.5 inches diameter for rounds and squares. There are two sets of compression platforms, each of which has ball-and-socket seat at one end of the machine. The maximum distance from face to face of the tension holders is 48 inches. The distance from face to face of the compression platforms is 56.7 inches. The maximum piston speeds are—

	Inches per minute.
With one accumulator weight:	
For tension	4.3
For compression	6.3
With two accumulator weights:	
For tension	8.2
For compression	9.6
With three accumulator weights:	
For tension	10
For compression	12.6

The larger ram only of the accumulator is used with this testing machine. The minimum rate of speed of the piston admits of control to less than 0.01 inch per minute, and specimens may be strained small distances at will, measured by ten-thousandths of an inch.

Plate No. 5 is a view of the impact machine. It is adapted for experiments with striking velocities up to 20 feet per second. It consists of an anvil carrier and anvil of about 30,000 pounds weight, supported by a base plate of about the same weight. Mounted over the anvil is an hydraulic cylinder with piston for hoisting the ram. Rams up to 1,000 pounds weight are at present provided. There are solid and annular anvils. By means of an hydraulic gripping head the rams are hoisted, a prompt release of the ram being effected by retraction springs acting on the piston of the gripping head. Stems in the upper ends of the rams are used in the hoisting. The movements of the piston hoist and gripping head are controlled by valves shown at the right side of the machine. There are eight 8-inch leveling screws in the heavy flange at the lower end of the anvil carrier, below the floor line of the room, working against the base plate, for adjusting the face of the anvil to a horizontal plane. The machine rests upon a platform 9 feet 6 inches square by 3 feet deep, of spruce timber, kyanized for its preservation.



NO. 5.

IMPACT TESTING MACHINE.

NO. 6.

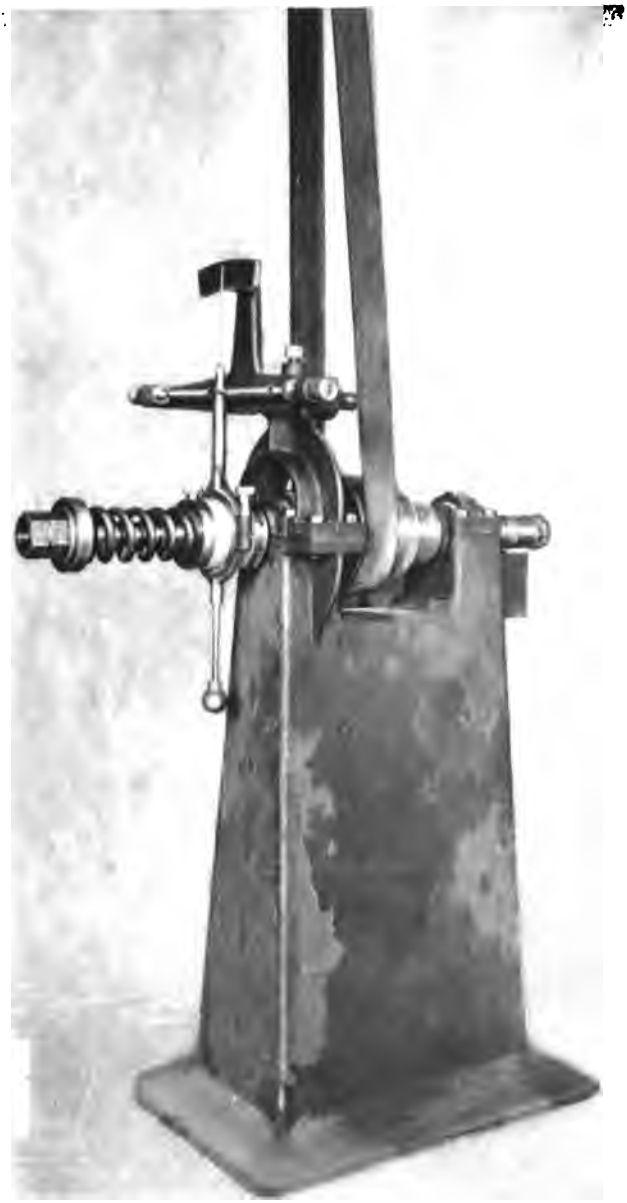
REPEATED STRESS MACHINE.

CAMPBELL ART CO.

Plate No. 6 represents the repeated stress machine. This machine provides for testing the endurance of steel and other metals under repeated alternate stresses of tension and compression by means of transverse loads applied to rotating shafts. The test shafts are 1 inch diameter by 33 inches long, center to center of end supports, and are loaded at two places at middle of the span, the middle bearings being 4 inches apart, center to center. The several bearings are mounted upon trunnions carried by swiveled blocks. The usual speed of rotation is 500 per minute. Four shafts may be under test at a time, two driven by each outside spindle. The third, middle spindle, was intended for the test of tubing, and provision made for applying longitudinal loads of tension or compression with transverse stresses. The middle spindle also provides a place for testing special shafts, at higher speeds of rotation, for which a De Laval steam turbine has been procured, having a normal rated speed of 38,000 rotations per minute.

Shafts are tested under different maximum fiber stresses, the experiments having covered a range of from 10,000 to 60,000 pounds per square inch.

Plate No. 7 shows a ball-bearing thrust shaft testing apparatus. It has a capacity for the test of balls up to a diameter of 2½ inches, which may be run at different speeds and under different thrust pressures. The thrust pressure is obtained by means of a calibrated helical spring, located on the spindle of the apparatus and rotating therewith. Two circles of balls are acted upon, between which a middle racer is placed, embraced by end ones. The middle racer has ball tracks on each face—the end racers on one end each. The latter rotate with the shaft, while the former remains stationary, excepting a rotary movement over a small angle, which is indicated by an arc and pointer. The angle indicated by the pointer is a measure of the frictional resistance of the bearing. A collar is clamped to the middle racer with arms on opposite sides, diametrically. The upper arm is held against angular movement by helical springs, but responds to the frictional resistance of the bearing, and moves over an angle, greater or less, according to the resistance of the bearing. The number of rotations of the spindle is shown by a counter attached thereto.



No. 7.

BALL BEARING THRUST SHAFT MACHINE.

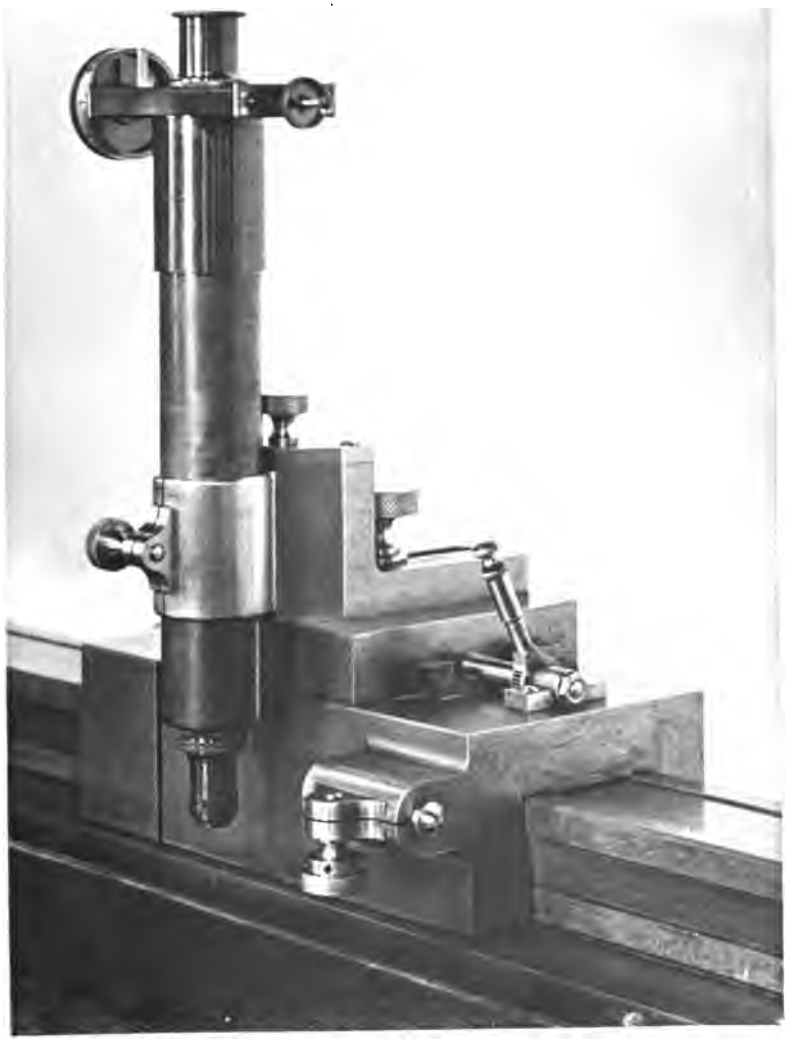
NO. 8.

C[illegible], FOR LINE AND END STANDARDS OF LENGTH.

CAMPBELL ART CO.
ELIZABETH, N. J.

Plate No. 8 represents the comparator for line standard and end standard measures of length. It has a capacity for laying off distances up to 100 inches. It consists of a cast-iron bed with a tongue along the upper side for carrying the microscope carriages, and with seats on each side on which line or end standard bars are placed. The bearing surfaces of the tongue and seats for standard bars are finished closely approaching true planes, parallel to each other. There is an independent platform along one side of the bed, on which may be placed and adjusted apparatus for examination.

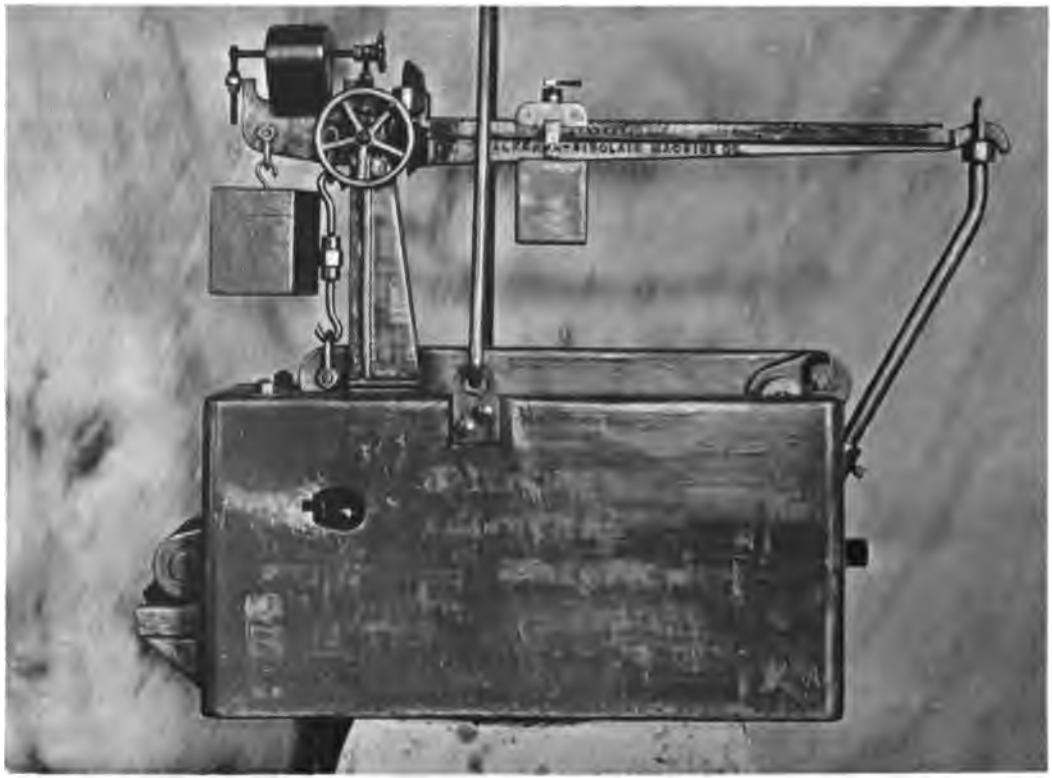
Plate No. 9 is a larger view of one of the microscope carriages. It shows a microscope in position, which is provided with an objective with illuminating prism for opaque objects, and filar micrometer eyepiece. A contact point for end measures is shown, clamped in the lug attached to the body of the micrometer carriage. The distance traveled by the microscope carriage in laying off any desired length is read off by observations upon the graduations of a line standard bar. The line standard bar for use with the comparator was graduated by Mr. George M. Bond.



NO. 9.

MICROSCOPE CARRIAGE OF COMPARATOR.

CAMPBELL ART CO
ELIZABETH, N. J



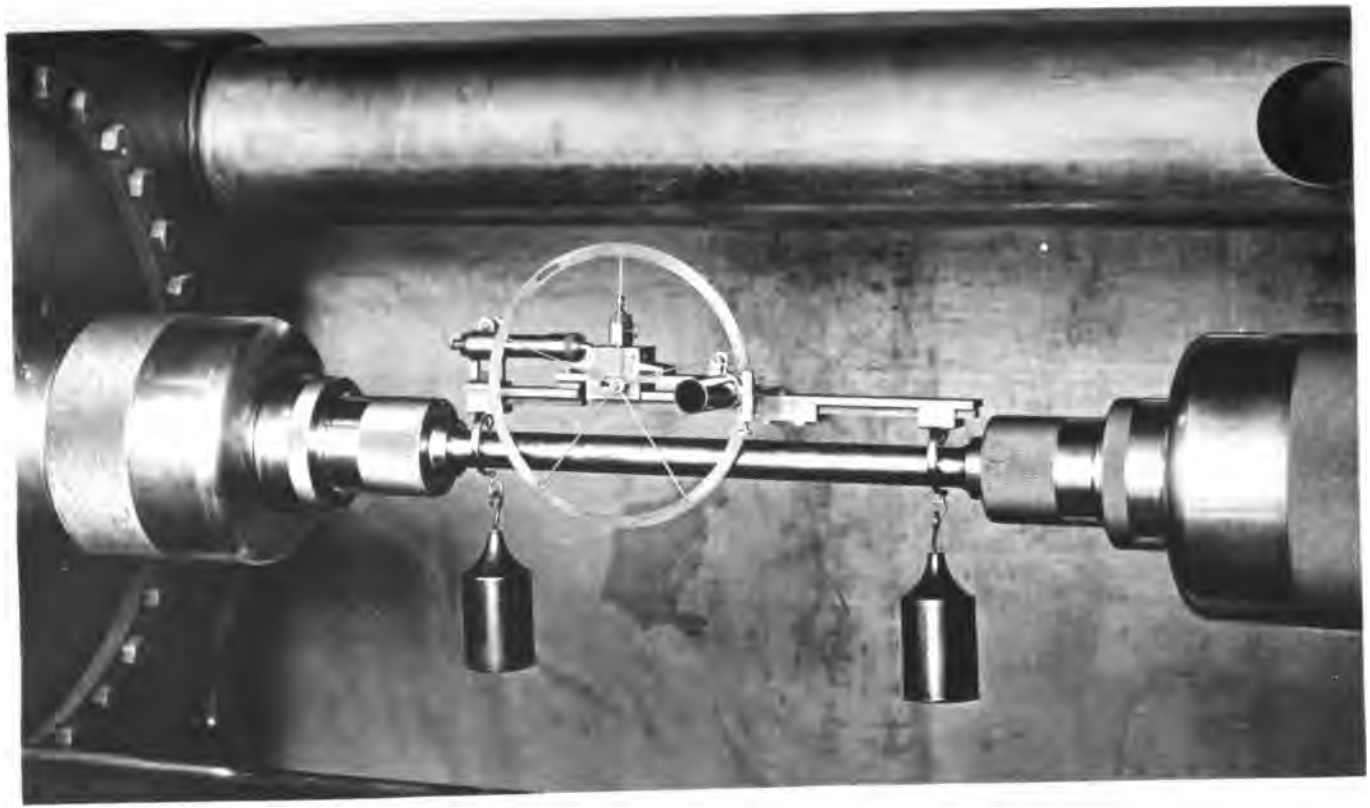
NO. 10.

TEST LEVERS, 50,000 POUNDS CAPACITY.

CAMPBELL ART CO.

Plate No. 10 shows a system of test levers for loads of tension, of 50,000 pounds capacity. It was made by the Falkenau-Sinclair Machine Company, from a design by Mr. J. W. Bramwell. It is a self-contained system, and may be attached to horizontal testing machines for purposes of comparison, in the same manner that tensile test pieces with threaded ends are attached. The weight of the levers is taken by a traveling crane or other means, from which the system is suspended at the height of the center line of the machine under comparison.

An extensometer with both indicating dial and screw micrometer is shown by plate No. 11. The instrument is also provided with an arc and pointer, which may be used instead of the dial. As here shown, the extensometer is in position on a test piece of 10 inches gauged length. In the construction of the instrument there are two beams, one of which has an offset and over-laps the other. Each beam carries a gibbed block with conical point for making contact with the specimen. These blocks may be slid into position and there clamped to accommodate specimens of any gauged length from 1 inch upward. The beams partake of the movements of the test piece within its gauged length. The overlapping part of one beam runs between rollers—two above and one below it. The rollers are 0.10 inch diameter each, carefully ground to cylindrical form, and work between scraped surfaces. The lower roller carries the dial or, when an arc and pointer is used, it carries the pointer. The beams are pressed together, with sufficient force upon the rollers to prevent their slipping, by means of a small helical spring contained in the cylindrical top of the instrument, acting through a pivoted foot attached to the T-shaped end of the piston within. The dial is graduated to read to thousandths of an inch, the arc and the screw micrometer to half-thousandths of an inch each. Ten-thousandths of an inch are taken by estimation. By means of extension rods the instrument may be adapted to any length of specimen up to the limits of the testing machine. It is used upon compression as well as tension specimens. When attached to wire of small diameter, inverted V-shaped contact blocks are used in place of the conical points.



NO. 11.

DIAL EXTENSOMETER, WITH SCREW MICROMETER.

CAMPBELL ART CO.
ELIZABETH, N. J.

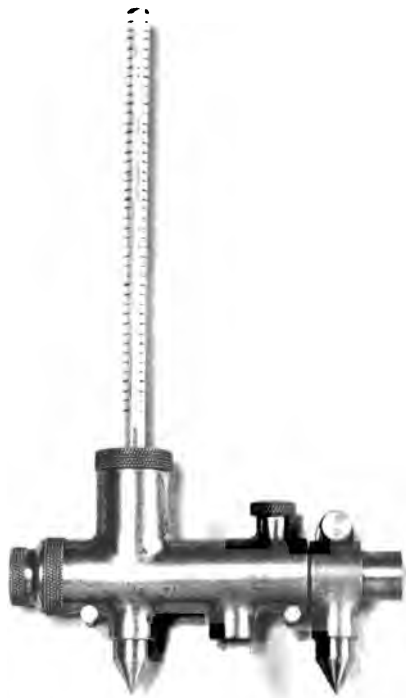
NO. 12.

SLIDING FRAME EXTENSOMETER.

CAMPBELL ART CO.
ELIZABETH, N. J.

Plate No. 12 shows a sliding frame with screw micrometer in position for measuring extensions. The micrometer is placed in the opposite end when the instrument is used for measuring compressive strains. This instrument is adapted for specimens 10 inches long and upward. The extension rods are one-half inch diameter. The sliding parts are usually counterweighted to reduce frictional resistance

Plate No. 13 represents a mercury column extensometer. It has a cylinder with piston 0.50 inch diameter, in communication with a graduated glass tube of small diameter of bore. Glass tubes of different diameters may be used, a convenient size being one which gives a magnification to the instrument of about 50. The instrument is intended for rapid work on material which has a sharply defined elastic limit. It is held in position by the hand, keeping the conical points engaged in punch marks on the specimen, which define the limits of the gauged length. The relations of stress and strain are judged of during the progress of the test, and a change in the rate of elongation readily recognized. The plate shows the instrument arranged for a 2-inch gauged length. It may be used conveniently on specimens from 1 to 20 inches long.



NO. 13.

MERCURY VOLUME EXTENSOMETER.

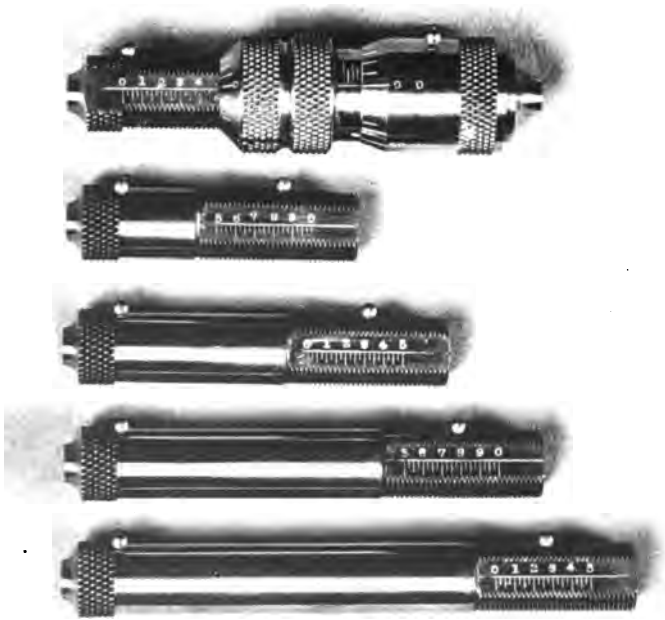
NO. 14.

INCLINOMETER.

CAMPBELL ART CO
ELIZABETH, N. J.

Plate No. 14 represents an inclinometer. It consists of a sensitive level bubble in a housing mounted over a frame carrying fixed and micrometer points. Both the fixed and micrometer points are adjustable as regards height. The housing of the bubble has a coarse adjustment by means of a milled nut and small helical spring. The micrometer head is graduated to read half-thousandths of an inch. The sensitiveness of the bubble is such that a difference in level of one ten-thousandths of an inch over a length of 12 inches, the distance from the micrometer to the fixed point, causes a travel of the bubble of 0.05 inch.

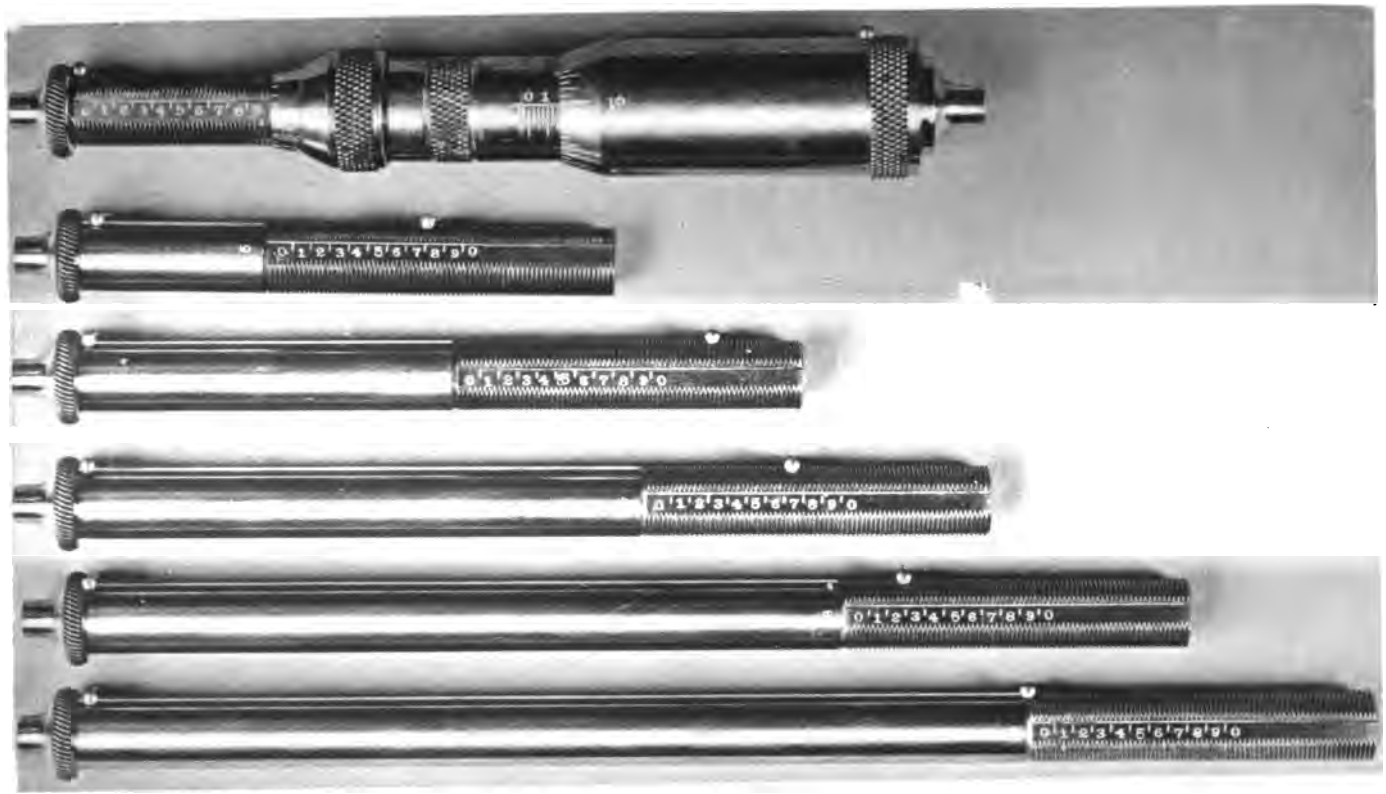
Plates Nos. 15, 16, and 17 show three sets of micrometer points for the measurement of interior diameters. The set represented by plate No. 15 has a normal range from 2 to 4½ inches, advancing by half inches. Inasmuch as the micrometer screw has a travel of 0.10 inch each way from the zero mark, the total range of the set is from 1.9 inches to 4.6 inches. The extension pieces are graduated and adjusted to the definite lengths which the instrument is intended to define. Plate No. 16 represents a set of points having a capacity of from 4 to 12 inches, advancing by inches. The micrometer screw has a travel of 1 inch. The extension pieces are graduated and adjusted to definite lengths. This set comprises 7 extension pieces, the longest of which is not shown by the plate. Plate No. 17 represents a set of points with which intermediate wooden bodies are used. It has a capacity of from 10 inches upward, advancing by lengths of 5 inches each. The micrometer screw has a travel of 1 inch. The steel extension point has a travel of 5 inches. Adjustment of this instrument to a definite length is done by means of the comparator, the measuring points of which are brought to the required distance apart. In order to facilitate adjustment of this instrument to a fixed length, with the micrometer reading initially at zero, an adjustment of the point of the extension piece is provided.



N.C. 15.

MICROMETER FOR INTERIOR DIAMETERS. RANGE, 1.9 IN. TO 4.6 IN.

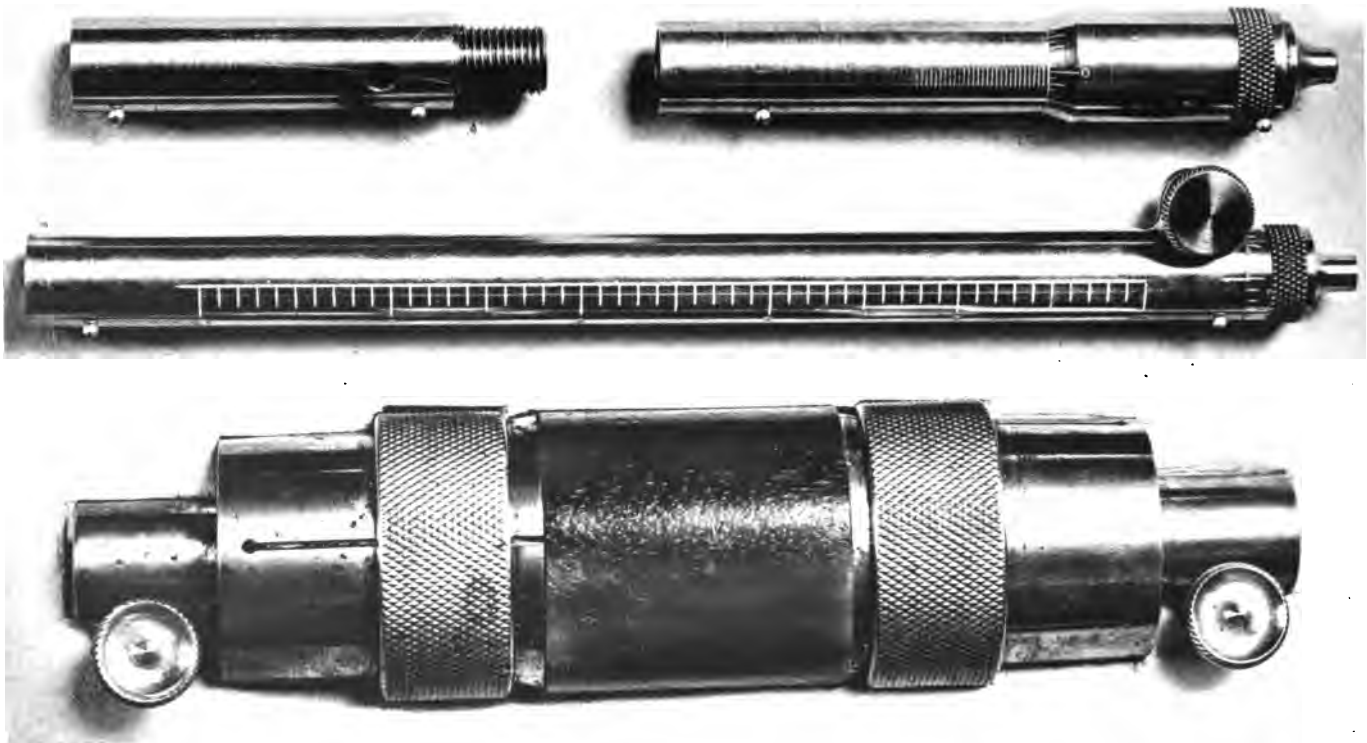
CAMPBELL ART CO.
ELIZABETH N. J.



NO. 16.

MICROMETER FOR INTERIOR DIAMETERS. RANGE, 4 IN. TO 12 IN.

CAMPBELL ART CO.
ELIZABETH, N. J.



NO. 17.

MICROMETER FOR INTERIOR DIAMETERS. RANGE, FROM 10 IN. UPWARDS.

CAMPBELL ART CO.
ELIZABETH, N. J.

NC. 18.

MICROMETER, MEASURING AND FIXED POINTS, FOR EXTERIOR DIAMETERS.

CAMPBELL ART CO.

For measurements of exterior diameters the micrometer and fixed points are used which are shown on plate No. 18. These are used in steel caliper arms, lagged with wood, in sizes advancing by lengths of 5 inches each. The micrometer screw has a travel of 0.25 inch each way from the zero line. The adjustment of the points in the caliper arms is done by means of the comparator, or by reference to end standards of length. To facilitate adjustment to definite lengths, with the micrometer at zero, the fixed point is provided with an adjustable contact point.

It is customary to lay off, initially, the stems of tensile specimens into sections 1 inch long each and to measure the extension of each of the several inch sections after rupture. Plates Nos. 19 and 20 show the devices which are employed for this purpose. Plate No. 19 shows multiple punches of 3, 6, and 10 inches length, respectively, for the initial laying off of specimens into inch sections. The stems of the individual punches work in their respective beams in holes spaced 1 inch apart, center to center. The end points of each beam are from 0.01 to 0.02 inch longer than the intermediate points. This aids in keeping the punch in place, the terminal points being the first ones used.

Plate No. 20 shows three graduated beams, on one of which are two sliding blocks carrying conical points, one being provided with a vernier plate. In use the sliding blocks are adjusted on one of the beams, the shorter block clamped in place and the longer one left movable. The conical point of the movable block is successively brought into each of the punch marks defining the inch sections of the specimen, the conical point of the fixed block being held in one of the end punch marks during this time. The several readings of the vernier of the movable block thus indicate the elongated distances, and the differences of readings indicate the elongation of each inch section into which the specimen was initially laid off.

The machines and apparatus above described, and not otherwise designated, were designed by Mr. Howard, in charge of the testing laboratory, much of the apparatus having been made in the machine shop attached to the laboratory.

The equipment further comprises a microscopic outfit for the examination of steels and other opaque objects and making photomicrographs of the same. There are electrical and optical pyrometers, electric and gas furnaces for specimens of small sizes, a polishing wheel, and also a cement briquette tensile testing machine. There is a fully equipped chemical laboratory for iron and steel and other materials of construction and for the examination of oils, and also provided with photographic apparatus. The main room of the testing laboratory is provided with an electric traveling crane of 5 ton capacity. A small machine shop is attached, containing tools for the preparation of test pieces and for the construction of special testing fixtures and apparatus.

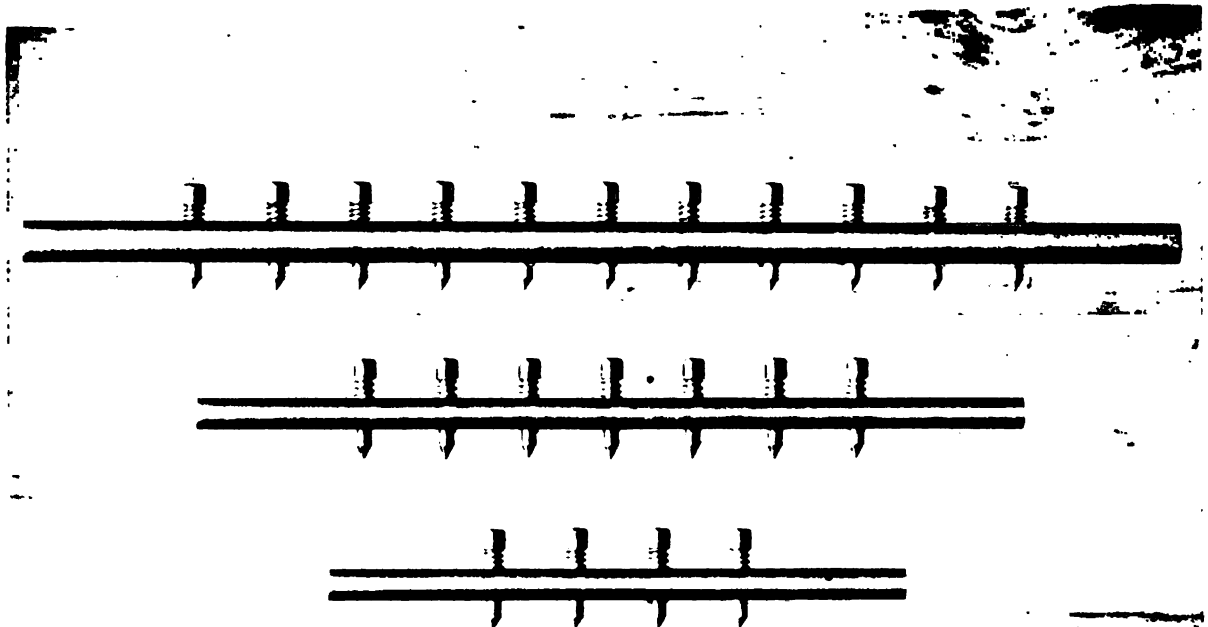


FIG. 13.

MULTIPLE LANCING-OFF PUNCHES.

CAMPBELL ART CO.
ELIZABETH, N. J.

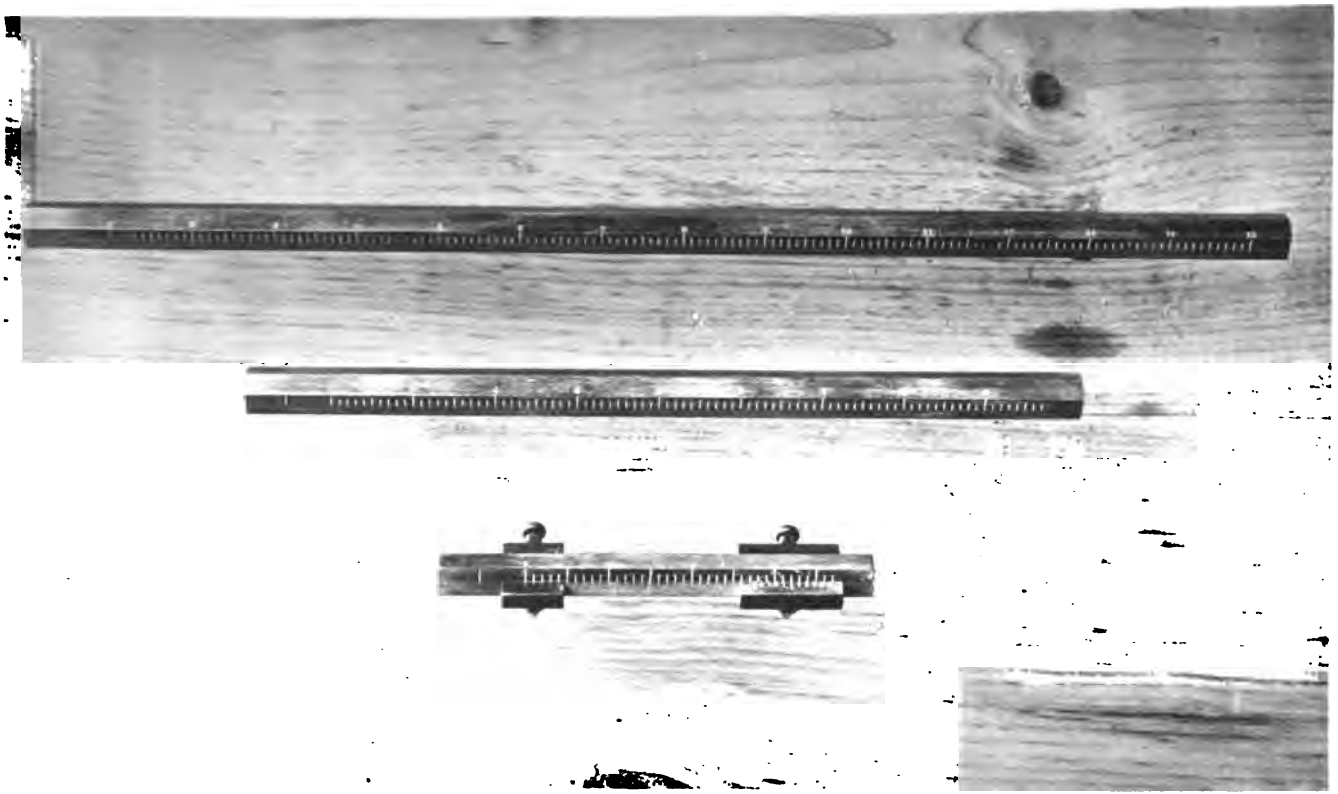


FIG. 27.

BEAMS WITH GAUGES FOR MEASUREMENT OF ELONGATIONS AFTER FRACTURE.

CAMPBELL ART CO.
ELIZABETH, N. J.

3-INCH R. F. GUNS.

SPECIMENS FROM TUBES, JACKETS, LOCKING HOOPS, BREECHBLOCKS, AND BREECH BUSHING.

TUBE.

No. 8191.

Marks, $\frac{49934B_1}{BT_2M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
30,000	.00080	.00070	.....	.....	
40,000	.00110	.00030	.....	.....	
50,000	.00150	.00040	0.	0.	
55,000	.00170	.00020	.....	.....	
60,000	.00180	.00010	.....	.....	
65,000	.00200	.00020	.....	.....	
67,000	.00210	.00010	.....	.....	Elastic limit.
68,000	.00225	.00015	.....	.....	
69,000	.00320	.00095	.....	.....	
70,000	.00470	.00150	.....	.....	
71,000	.00575	.00105	.....	.....	
72,000	.00650	.00075	.....	.....	
108,500	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	108,500
Elastic limit per square inch of original section	do...	67,000
Elongation per inch after rupture	inch..	.185
Elongation per inch under strain at elastic limit	do...	.00210
Reduction in diameter at point of rupture	do...	.115
Reduction in area after rupture, per cent of original section		40.3
Position of rupture		1".09 from the neck
Character of broken surface		silky
Elongation of inch sections		".14, ".23*

TUBE.

No. 8196.

Marks, $\frac{64878\ B_2}{BT_2M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00025	.00015	.....	.....	
30,000	.00080	.00055	.....	.....	
40,000	.00115	.00035	.....	.....	
50,000	.00140	.00025	0.	0.	
55,000	.00160	.00020	.....	.....	
60,000	.00180	.00020	.....	.....	
65,000	.00190	.00010	.....	.....	
66,000	.00200	.00010	.....	.....	
67,000	.00230	.00030	.....	.....	Elastic limit
68,000	.00335	.00105	.....	.....	
69,000	.00600	.00265	.....	.....	
70,000	.00750	.00150	.....	.....	
71,000	.00800	.00050	.....	.....	
72,000	.00905	.00105	.....	.....	
110,500	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	110,500
Elastic limit per square inch of original section	do...	67,000
Elongation per inch after rupture	inch..	.18
Elongation per inch under strain at elastic limit	do...	.00230
Reduction in diameter at point of rupture	do...	.095
Reduction in area after rupture, per cent of original section		34
Position of rupture		".90 from the neck
Character of broken surface		silky, oblique
Elongation of inch sections		".11, ".25*

TUBE.

No. 8200.

Marks, $\frac{64764B_1}{BT_1M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00025	.00010	.....	.....	
30,000	.00085	.00080	.....	.....	
40,000	.00115	.00030	.....	.....	
50,000	.00150	.00035	0.	0.	
55,000	.00165	.00015	.....	.....	
60,000	.00180	.00015	.....	.....	
65,000	.00200	.00020	.....	.....	Elastic limit.
66,000	.00435	.00235	.....	.....	
67,000	.00695	.00260	.....	.....	
69,000	.00850	.00155	.....	.....	
70,000	.00950	.00100	.....	.....	
112,500	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	112,500
Elastic limit per square inch of original section	do...	65,000
Elongation per inch after rupture	inch..	.19
Elongation per inch under strain at elastic limit	do...	.00200
Reduction in diameter at point of rupture	do...	.095
Reduction in area after rupture, per cent of original section		34
Position of rupture		".8 from the neck
Character of broken surface		silky
Elongation of inch sections		".13, .".25*

TUBE.

No. 8203.

Marks, $\frac{64875\ B_1}{BT_3M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00035	.00020	.....	.....	
30,000	.00095	.00060	.....	.....	
50,000	.00160	.00065	0.	0.	
55,000	.00180	.00020	.....	.....	
60,000	.00195	.00015	.....	.....	
65,000	.00220	.00025	.....	.....	Elastic limit.
66,000	.00275	.00055	.....	.....	
67,000	.00655	.00380	.....	.....	
68,000	.00765	.00110	.....	.....	
109,000	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	109,000
Elastic limit per square inch of original section	do...	65,000
Elongation per inch after rupture	inch..	.185
Elongation per inch under strain at elastic limit	do...	.00220
Reduction in diameter at point of rupture	do...	.095
Reduction in area after rupture, per cent of original section		34
Position of rupture		1" from the neck
Character of broken surface		silky
Elongation of inch sections		".24*, ".13

TUBE.

No. 8204.

Marks, $\frac{49931\ B_1}{BT_2M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00035	.00020	.....	.....	
30,000	.00110	.00075	.....	.....	
40,000	.00145	.00035	.....	.....	
50,000	.00180	.00035	0.	0.	
55,000	.00195	.00015	.....	.....	
60,000	.00210	.00015	.....	.....	
64,000	.00225	.00015	.....	.....	Elastic limit.
65,000	.00320	.00095	.....	.....	
66,000	.00465	.00145	.....	.....	
67,000	.00540	.00075	.....	.....	
68,000	.00625	.00085	.....	.....	
69,000	.00715	.00090	.....	.....	
70,000	.00840	.00125	.....	.....	
106,000	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	106,000
Elastic limit per square inch of original section	do...	64,000
Elongation per inch after rupture	inch..	.170
Elongation per inch under strain at elastic limit	do...	.00225
Reduction in diameter at point of rupture	do...	.085
Reduction in area after rupture, per cent of original section		30.7
Position of rupture		".75 from the neck
Character of broken surface		silky
Elongation of inch sections		".23*, ".11

TUBE.

No. 8207.

Marks, $\frac{66665\ B_1}{BT_2M}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00025	.00015			
30,000	.00085	.00060			
50,000	.00145	.00060	0.	0.	
55,000	.00160	.00015			
60,000	.00180	.00020			
65,000	.00200	.00020			
70,000	.00220	.00020			Elastic limit.
71,000	.00500	.00280			
72,000	.00820	.00320			
73,000	.00900	.00080			
74,000	.01000	.00100			
112,000					Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds.	112,000
Elastic limit per square inch of original section	do...	70,000
Elongation per inch after rupture	inch..	.170
Elongation per inch under strain at elastic limit	do...	.00220
Reduction in diameter at point of rupture	do...	.105
Reduction in area after rupture, per cent of original section		37.1
Position of rupture		at middle of stem
Character of broken surface		silky
Elongation of inch sections		″.19*, ″.15*

TUBE.

No. 8210.

Marks, $\frac{66655\ B_3}{BT_3M}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00025	.00015	.....	.....	
30,000	.00100	.00075	.....	.....	
50,000	.00160	.00060	0.	0.	
55,000	.00185	.00025	.....	.....	
60,000	.00195	.00010	.....	.....	
65,000	.00210	.00015	.....	.....	
70,000	.00235	.00025	.....	.....	Elastic limit.
71,000	.00275	.00040	.....	.....	
72,000	.00825	.00550	.....	.....	
73,000	.00930	.00105	.....	.....	
107,500	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	107,500
Elastic limit per square inch of original section	do...	70,000
Elongation per inch after rupture	inch..	.205
Elongation per inch under strain at elastic limit	do...	.00235
Reduction in diameter at point of rupture	do...	.125
Reduction in area after rupture, per cent of original section		43.3
Position of rupture		″.9 from the neck
Character of broken surface		silky
Elongation of inch sections		″.13, ″.28

TUBE.

No. 8211.

Marks, $\frac{68469\ B_1}{BT_2M}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00025	.00015	.....	.....	
30,000	.00095	.00070	.....	.....	
50,000	.00160	.00065	0.	0.	
55,000	.00175	.00015	.....	.....	
60,000	.00190	.00015	.....	.....	
65,000	.00210	.00020	.....	.....	
70,000	.00230	.00020	.....	.....	
72,000	.00240	.00010	.....	.....	Elastic limit.
73,000	.00425	.00185	.....	.....	
74,000	.00765	.00340	.....	.....	
75,000	.00895	.00130	.....	.....	
114,500	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	114,500
Elastic limit per square inch of original section	do...	72,000
Elongation per inch after rupture	inch..	.175
Elongation per inch under strain at elastic limit	do...	.00240
Reduction in diameter at point of rupture	do...	.095
Reduction in area after rupture, per cent of original section		34
Position of rupture		″.95 from the neck
Character of broken surface		silky
Elongation of inch sections		″.11, ″.24*

TUBE.

No. 8212.

Marks, 3–B1.
Diameter, ″.507.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00035	.00020	.....	.....	
30,000	.00090	.00055	.....	.....	
50,000	.00160	.00070	0.	0.	
55,000	.00180	.00020	.....	.....	
60,000	.00195	.00015	.....	.....	
65,000	.00225	.00030	.....	.....	Elastic limit.
66,000	.00235	.00010	.....	.....	
67,000	.00255	.00020	.....	.....	
68,000	.00275	.00020	.....	.....	
69,000	.00305	.00030	.....	.....	
70,000	.00355	.00050	.....	.....	
71,000	.00450	.00095	.....	.....	
72,000	.00590	.00140	.....	.....	
109,500	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	109,500
Elastic limit per square inch of original section	do...	65,000
Elongation per inch after rupture	inch..	.200
Elongation per inch under strain at elastic limit	do...	.00225
Reduction in diameter at point of rupture	do...	.115
Reduction in area after rupture, per cent of original section		40.3
Position of rupture		at middle of stem
Character of broken surface		silky
Elongation of inch sections		″.21*, ″.19*

TUBE.

No. 8218.

Marks, $\frac{66654\ B_2}{BT_2M}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00030	.00015	.....	.....	
30,000	.00100	.00070	.....	.....	
50,000	.00170	.00070	0.	0.	
55,000	.00180	.00010	.....	.....	
60,000	.00200	.00020	.....	.....	
65,000	.00215	.00015	.....	.....	
70,000	.00235	.00020	.....	.....	
72,000	.00245	.00010	.....	.....	Elastic limit.
73,000	.00640	.00395	.....	.....	
74,000	.00995	.00355	.....	.....	
75,000	.01065	.00070	.....	.....	
113,000	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	113,000
Elastic limit per square inch of original section	do...	72,000
Elongation per inch after rupture	inch..	.180
Elongation per inch under strain at elastic limit	do...	.00245
Reduction in diameter at point of rupture	do...	.095
Reduction in area after rupture, per cent of original section		34
Position of rupture		″.70 from the neck
Character of broken surface		silky
Elongation of inch sections		″.10, ″.26*

TUBE.

No. 8263.

Marks, $\frac{66674\ B_1}{BT_4M}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00025	.00015			
30,000	.00100	.00075			
50,000	.00170	.00070	0.	0.	
55,000	.00190	.00020			
60,000	.00205	.00015			
65,000	.00225	.00020			
70,000	.00255	.00030			Elastic limit.
71,000	.00355	.00100			
72,000	.00525	.00170			
73,000	.00675	.00150			
112,000					Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	112,000
Elastic limit per square inch of original section	do...	70,000
Elongation per inch after rupture	inch..	.200
Elongation per inch under strain at elastic limit	do...	.00255
Reduction in diameter at point of rupture	do...	.125
Reduction in area after rupture, per cent of original section		43.3
Position of rupture		at middle of stem
Character of broken surface		silky
Elongation of inch sections		″.23*, ″.17*

TUBE.

No. 8267.

Marks, $\frac{3RF\ 6T}{BT;O}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00020	.00020	0.	0.	
10,000	.00035	.00015			
30,000	.00105	.00070			
50,000	.00180	.00075	0.	0.	
55,000	.00195	.00015			
60,000	.00210	.00015			
65,000	.00220	.00010			
68,000	.00240	.00020			
69,000	.00250	.00010			Elastic limit
70,000	.00320	.00070			
71,000	.00390	.00070			
72,000	.00505	.00115			
73,000	.00660	.00155			
113,500					Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	113,500
Elastic limit per square inch of original section	do...	69,000
Elongation per inch after rupture	inch..	.190
Elongation per inch under strain at elastic limit	do...	.00250
Reduction in diameter at point of rupture	do...	.115
Reduction in area after rupture, per cent of original section		40.3
Position of rupture		″.60 from the neck
Character of broken surface		silky
Elongation of inch sections		″.11, ″.27*

TUBE.

No. 8271.

Marks, $\frac{68483\ B_1}{BT_2M}$
Diameter," .505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00025	.00015	.....	.....	
30,000	.00085	.00060	.....	.....	
50,000	.00150	.00065	0.	0.	
55,000	.00170	.00020	.....	.....	
60,000	.00195	.00025	.....	.....	
63,000	.00205	.00010	.....	.....	Elastic limit.
64,000	.00755	.00550	.....	.....	
65,000	.00800	.00045	.....	.....	
66,000	.00900	.00100	.....	.....	
106,000	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	106,000
Elastic limit per square inch of original section	do...	63,000
Elongation per inch after rupture	inch..	.195
Elongation per inch under strain at elastic limit	do...	.00205
Reduction in diameter at point of rupture	do...	.105
Reduction in area after rupture, per cent of original section		37.1
Position of rupture		1". 2 from the neck
Character of broken surface		silky
Elongation of inch sections		".15, ".24

TUBE.

No. 8278.

Marks, $\frac{68466\ B_1}{BT_4M}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00025	.00015	.....	.....	
30,000	.00080	.00055	.....	.....	
50,000	.00150	.00070	0.	0.	
55,000	.00175	.00025	.....	.....	
60,000	.00190	.00015	.....	.....	
65,000	.00210	.00020	.....	.....	
67,000	.00220	.00010	.....	.....	Elastic limit.
68,000	.00255	.00035	.....	.....	
69,000	.00350	.00095	.....	.....	
70,000	.00670	.00320	.....	.....	
114,000	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	114,000
Elastic limit per square inch of original section	do...	67,000
Elongation per inch after rupture	inch..	.170
Elongation per inch under strain at elastic limit	do...	.00220
Reduction in diameter at point of rupture	do...	.105
Reduction in area after rupture, per cent of original section		37.1
Position of rupture		″.50 from the neck
Character of broken surface		silky
Elongation of inch sections		″.23*, ″.11

TUBE.

No. 8280.

Marks, $\frac{68482\ B_1}{BT_2M}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00025	.00015	.....	.....	
30,000	.00095	.00070	.....	.....	
50,000	.00165	.00070	0.	0.	
55,000	.00175	.00010	.....	.....	
60,000	.00200	.00025	.....	.....	
65,000	.00220	.00020	.....	.....	
66,000	.00230	.00010	.....	.....	Elastic limit.
67,000	.00305	.00075	.....	.....	
68,000	.00975	.00670	.....	.....	
69,000	.01050	.00075	.....	.....	
112,500	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	112,500
Elastic limit per square inch of original section	do...	66,000
Elongation per inch after rupture	inch..	.200
Elongation per inch under strain at elastic limit	do...	.00230
Reduction in diameter at point of rupture	do...	.115
Reduction in area after rupture, per cent of original section		40.3
Position of rupture		″.90 from the neck
Character of broken surface		silky
Elongation of inch sections		″26.*, ″.14

JACKET.

No. 8193.

Marks, $\frac{65304\ B_8}{BT_1M}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
30,000	.00085	.00075	.....	.....	
40,000	.00110	.00025	.....	.....	
50,000	.00145	.00035	0.	0.	
55,000	.00160	.00015	.....	.....	
60,000	.00175	.00015	.....	.....	
65,000	.00195	.00020	.....	.....	
68,000	.00215	.00020	.....	.....	
69,000	.00220	.00005	.....	.....	Elastic limit.
70,000	.00240	.00020	.....	.....	
71,000	.00260	.00020	.....	.....	
72,000	.00285	.00025	.....	.....	
73,000	.00350	.00065	.....	.....	
74,000	.00470	.00120	.....	.....	
115,500	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	115,500
Elastic limit per square inch of original section	do...	69,000
Elongation per inch after rupture	inch..	.155
Elongation per inch under strain at elastic limit	do...	.00220
Reduction in diameter at point of rupture	do...	.085
Reduction in area after rupture, per cent of original section		30.7
Position of rupture		″.60 from the neck
Character of broken surface		silky, 55 per cent; granular, 45 per cent
Elongation of inch sections		″.22*, ″.09

JACKET.

No. 8198.

Marks, $\frac{66377\ B_8}{BT_1M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00030	.00020	.....	.....	
30,000	.00090	.00060	.....	.....	
40,000	.00125	.00035	.....	.....	
50,000	.00160	.00035	.....	.....	
55,000	.00180	.00020	.....	.....	
60,000	.00195	.00015	.....	.....	
65,000	.00215	.00020	.....	.....	
70,000	.00235	.00020	.....	.....	Elastic limit.
	.00390	.00155			
71,000	.00785	.00395	.....	.....	
72,000	.00860	.00075	.....	.....	
73,000	.00960	.00100	.....	.....	
74,000	.01070	.00110	.....	.....	
75,000	.01140	.00070	.....	.....	
110,500	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	110,500
Elastic limit per square inch of original section	do...	70,000
Elongation per inch after rupture	inch..	.175
Elongation per inch under strain at elastic limit	do...	.00235
Reduction in diameter at point of rupture	do...	.075
Reduction in area after rupture, per cent of original section		27.4
Position of rupture		".9 from the neck
Character of broken surface		silky
Elongation of inch sections		".23", ".12

JACKET.

No. 8199.

Marks, $\frac{66878\ B_1}{BT_1M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00030	.00015	.....	.....	
30,000	.00100	.00070	.....	.....	
40,000	.00130	.00030	.....	.....	
50,000	.00165	.00035	0.	0.	
55,000	.00180	.00015	.....	.....	
60,000	.00195	.00015	.....	.....	
65,000	.00215	.00020	.....	.....	
66,000	.00225	.00010	.....	.....	
67,000	.00235	.00010	.....	.....	Elastic limit.
68,000	.00370	.00135	.....	.....	
69,000	.00540	.00170	.....	.....	
70,000	.00685	.00145	.....	.....	
71,000	.00755	.00070	.....	.....	
72,000	.00875	.00120	.....	.....	
103,000	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	103,000
Elastic limit per square inch of original section	do...	67,000
Elongation per inch after rupture	inch..	.155
Elongation per inch under strain at elastic limit	do...	.00235
Reduction in diameter at point of rupture	do...	.065
Reduction in area after rupture, per cent of original section		23.9
Position of rupture		at middle of stem
Character of broken surface		silky
Elongation of inch sections		".13*,".18*

JACKET.

No. 8202.

Marks, $\overset{66766\ B_1}{B\ T_2M}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00035	.00025			
30,000	.00110	.00075			
40,000	.00130	.00020			
50,000	.00160	.00030	0.	0.	
55,000	.00185	.00025			
60,000	.00205	.00020			
64,000	.00215	.00010			Elastic limit.
65,000	.00300	.00085			
66,000	.00875	.00575			
67,000	.00940	.00065			
68,000	.01035	.00095			
106,500					Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	106,500
Elastic limit per square inch of original section	do...	64,000
Elongation per inch after rupture	inch..	.190
Elongation per inch under strain at elastic limit	do...	.00215
Reduction in diameter at point of rupture	do...	.095
Reduction in area after rupture, per cent of original section		34
Position of rupture		″.90 from the neck
Character of broken surface		silky, oblique
Elongation of inch sections		″.27*, ″.11

JACKET.

No. 8205.

Marks, $\frac{66543\ B_3}{B\ T_1M}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00030	.00020			
30,000	.00095	.00065			
50,000	.00155	.00060	.00005	.00005	
55,000	.00175	.00020			
60,000	.00210	.00035			Elastic limit.
61,000	.00525	.00315			
62,000	.00710	.00185			
63,000	.00800	.00090			
64,000	.00895	.00095			
103,000					Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	103,000
Elastic limit per square inch of original section	do...	60,000
Elongation per inch after rupture	inch..	.165
Elongation per inch under strain at elastic limit	do...	.00210
Reduction in diameter at point of rupture	do...	.095
Reduction in area after rupture, per cent of original section		34
Position of rupture		″.9 from the neck
Character of broken surface		silky
Elongation of inch sections		″.12, ″.21*

JACKET.

No. 8208.

Marks, 1014–M.
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00030	.00015			
30,000	.00100	.00070			
50,000	.00175	.00075	0.	0.	
55,000	.00185	.00010			
60,000	.00210	.00025			
62,000	.00220	.00010			Elastic limit.
63,000	.00260	.00040			
64,000	.00475	.00215			
65,000	.00700	.00225			
66,000	.00870	.00170			
99,500					Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	99,500
Elastic limit per square inch of original section	do...	62,000
Elongation per inch after rupture	inch..	.215
Elongation per inch under strain at elastic limit	do...	.00220
Reduction in diameter at point of rupture	do...	.135
Reduction in area after rupture, per cent of original section		46.2
Position of rupture		1″.1 from the neck
Character of broken surface		silky
Elongation of inch sections		″.17, ″.26*

JACKET.

No. 8209.

Marks, $\frac{67528\ B_2}{BT_2M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00020	.00010	.....	.....	
30,000	.00065	.00065	.....	.....	
50,000	.00150	.00065	−.00005	−.00005	
55,000	.00175	.00025	.....	.....	
60,000	.00195	.00020	.....	.....	
65,000	.00210	.00015	.....	.....	
70,000	.00230	.00020	.....	.....	Elastic limit.
71,000	.00250	.00020	.....	.....	
72,000	.00350	.00100	.....	.....	
73,000	.00475	.00125	.....	.....	
74,000	.00675	.00200	.....	.....	
112,000	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	112,000
Elastic limit per square inch of original section	do...	70,000
Elongation per inch after rupture	inch..	.185
Elongation per inch under strain at elastic limit	do...	.00230
Reduction in diameter at point of rupture	do...	.105
Reduction in area after rupture, per cent of original section		37.1
Position of rupture		1" from the neck
Character of broken surface		silky
Elongation of inch sections		".11 ".26*

JACKET.

No. 8213.

Marks, $\frac{66765\ B_1}{BT_3M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00020	.00010	.....	.....	
30,000	.00085	.00065	.....	.....	
50,000	.00155	.00070	0.	0.	
55,000	.00170	.00015	.....	.....	
60,000	.00185	.00015	.....	.....	
63,000	.00195	.00010	.....	.....	
64,000	.00200	.00005	.....	.....	Elastic limit.
65,000	.00220	.00020	.....	.....	
66,000	.00440	.00220	.....	.....	
67,000	.00650	.00210	.....	.....	
68,000	.00755	.00105	.....	.....	
107,000	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	107,000
Elastic limit per square inch of original section	do...	64,000
Elongation per inch after rupture	inch..	.150
Elongation per inch under strain at elastic limit	do...	.00200
Reduction in diameter at point of rupture	do...	.105
Reduction in area after rupture, per cent of original section		37.1
Position of rupture		".65 from the neck
Character of broken surface		silky, oblique
Elongation of inch sections		".08, ".22*

JACKET.

No. 8217.

Marks, $\frac{66878\ B_2}{BT_2M}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00025	.00015	.....	.....	
30,000	.00085	.00060	.....	.....	
50,000	.00155	.00070	0.	0.	
55,000	.00180	.00025	.....	.....	
60,000	.00195	.00015	.....	.....	
65,000	.00215	.00020	.....	.....	
70,000	.00240	.00025	.....	.....	
71,000	.00250	.00010	.....	.....	Elastic limit.
72,000	.00270	.00020	.....	.....	
73,000	.00425	.00155	.....	.....	
74,000	.00485	.00060	.....	.....	
75,000	.00600	.00115	.....	.....	
117,000	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	117,000
Elastic limit per square inch of original section	do...	71,000
Elongation per inch after rupture	inch..	.155
Elongation per inch under strain at elastic limit	do...	.00250
Reduction in diameter at point of rupture	do...	.085
Reduction in area after rupture, per cent of original section		30.7
Position of rupture		″.5 from the neck
Character of broken surface		silky; trace of granulation
Elongation of inch sections		″.21*, ″.10

JACKET.

No. 8219.

Marks, $\frac{68467\ B_1F_1}{BT_1M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00030	.00015	.....	.....	
30,000	.00095	.00065	.....	.....	
50,000	.00165	.00070	0.	0.	
55,000	.00175	.00010	.....	.....	
60,000	.00200	.00025	.....	.....	
64,000	.00215	.00015	.....	.....	Elastic limit.
65,000	.00270	.00055	.....	.....	
66,000	.00750	.00480	.....	.....	
67,000	.00900	.00150	.....	.....	
107,000	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	107,000
Elastic limit per square inch of original section	do...	64,000
Elongation per inch after rupture	inch..	.180
Elongation per inch under strain at elastic limit	do...	.00215
Reduction in diameter at point of rupture	do...	.085
Reduction in area after rupture, per cent of original section		30.7
Position of rupture		".9 from the neck
Character of broken surface		silky, in part granular
Elongation of inch sections		".22", ".14

JACKET.

No. 8220.

Marks, 1014–M.
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00030	.00015	.....	.....	
30,000	.00100	.00070	.....	.....	
50,000	.00170	.00070	0.	0.	
55,000	.00180	.00010	.....	.....	
60,000	.00200	.00020	.....	.....	
65,000	.00220	.00020	.....	.....	Elastic limit.
66,000	.00235	.00015	.....	.....	
67,000	.00300	.00065	.....	.....	
68,000	.00600	.00300	.....	.....	
69,000	.00740	.00140	.....	.....	
70,000	.00825	.00085	.....	.....	
106,000	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	106,000
Elastic limit per square inch of original section	do...	65,000
Elongation per inch after rupture	inch..	.200
Elongation per inch under strain at elastic limit	do...	.00220
Reduction in diameter at point of rupture	do...	.145
Reduction in area after rupture, per cent of original section		49.1
Position of rupture		at middle of stem
Character of broken surface		silky
Elongation of inch sections		″.24*, ″.16

JACKET.

No. 8268.

Marks, $\overset{3RF\ 9J}{BT_1M}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00025	.00010	.....	.....	
30,000	.00100	.00075	.....	.....	
50,000	.00175	.00075	0.	0	
55,000	.00190	.00015	.....	.....	
60,000	.00200	.00010	.....	.....	
65,000	.00220	.00020	.....	.....	
69,000	.00240	.00020	.....	.....	Elastic limit.
70,000	.00425	.00185	.....	.....	
71,000	.00700	.00275	.....	.....	
72,000	.00910	.00210	.....	.....	
110,500	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	110,500
Elastic limit per square inch of original section	do...	69,000
Elongation per inch after rupture	inch..	.190
Elongation per inch under strain at elastic limit	do...	.00240
Reduction in diameter at point of rupture	do...	.105
Reduction in area after rupture, per cent of original section		37.1
Position of rupture		″.55 from the neck
Character of broken surface		silky
Elongation of inch sections		″.26* ″.12

JACKET.

No. 8269.

Marks, $\frac{3RF\ 10J}{BT;M}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00025	.00015	.....	.....	
30,000	.00095	.00070	.....	.....	
50,000	.00150	.00055	0.	0.	
55,000	.00170	.00020	.....	.....	
60,000	.00185	.00015	.....	.....	
62,000	.00195	.00010	.....	.....	Elastic limit.
63,000	.00215	.00020	.....	.....	
64,000	.00270	.00055	.....	.....	
65,000	.00445	.00175	.....	.....	
66,000	.00650	.00205	.....	.....	
104,000	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	104,000
Elastic limit per square inch of original section	do...	62,000
Elongation per inch after rupture	inch..	.200
Elongation per inch under strain at elastic limit	do...	.00195
Reduction in diameter at point of rupture	do...	.135
Reduction in area after rupture, per cent of original section		46.2
Position of rupture		″.90 from the neck
Character of broken surface		silky
Elongation of inch sections		″.29*, ″.11

JACKET.

No. 8270.

Marks, $^{3RF\ 15J}_{MT_1M}$.
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00025	.00010	.....	.....	
30,000	.00085	.00060	.....	.....	
50,000	.00150	.00065	0.	0.	
55,000	.00160	.00010	.....	.....	
60,000	.00175	.00015	.....	.....	
65,000	.00190	.00015	.....	.....	
70,000	.00215	.00025	.....	.....	
71,000	.00220	.00005	.....	.....	Elastic limit.
72,000	.01360	.01140	.....	.....	
73,000	.01400	.00040	.....	.....	
74,000	.01530	.00130	.....	.....	
104,500	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	104,500
Elastic limit per square inch of original section	do...	71,000
Elongation per inch after rupture	inch..	.195
Elongation per inch under strain at elastic limit	do...	.00220
Reduction in diameter at point of rupture	do...	.105
Reduction in area after rupture, per cent of original section		37.1
Position of rupture		".50 from the neck
Character of broken surface		silky
Elongation of inch sections		".11,".28*

JACKET.

No. 8273.

Marks, $\frac{3RF\ 17J}{MT_1M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
68,000	.....	.....	.....	.....	Elastic limit.
69,000	.00545	.00545	.....	.....	
70,000	.00825	.00280	.....	.....	
71,000	.01060	.00235	.....	.....	
72,000	.01175	.00115	.....	.....	
107,000	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	107,000
Elastic limit per square inch of original section	do...	68,000
Elongation per inch after rupture	inch..	.205
Reduction in diameter at point of rupture	do...	.115
Reduction in area after rupture, per cent of original section		40.3
Position of rupture		at middle of stem
Character of broken surface		silky
Elongation of inch sections		".20* ".21*

JACKET.

No. 8274.

Marks, $\frac{3RF\ 18J}{MT_1M}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00025	.00015	.....	.....	
30,000	.00080	.00055	.....	.....	
50,000	.00150	.00070	0.	0.	
55,000	.00160	.00010	.....	.....	
60,000	.00175	.00015	.....	.....	
65,000	.00190	.00015	.....	.....	
69,000	.00200	.00010	.....	.....	Elastic limit.
70,000	.00220	.00020	.....	.....	
71,000	.00920	.00700	.....	.....	
72,000	.00950	.00030	.....	.....	
73,000	.01085	.00135	.....	.....	
106,000	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	106,000
Elastic limit per square inch of original section	do...	69,000
Elongation per inch after rupture	inch..	.160
Elongation per inch under strain at elastic limit	do...	.00200
Reduction in diameter at point of rupture	do...	.065
Reduction in area after rupture, per cent of original section		24
Position of rupture		at middle of stem
Character of broken surface		silky
Elongation of inch sections		″.16*, ″.16*

JACKET.

No. 8275.

Marks, $\frac{67349\ B_1}{BT_M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00030	.00015	.....	.....	
30,000	.00110	.00080	.....	.....	
50,000	.00185	.00075	0.	0.	
55,000	.00200	.00015	.....	.....	
60,000	.00215	.00015	.....	.....	Elastic limit.
61,000	.00225	.00010	.....	.....	
62,000	.00255	.00030	.....	.....	
63,000	.00550	.00295	.....	.....	
64,000	.00750	.00200	.....	.....	
65,000	.00820	.00070	.....	.....	
104,500	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	104,500
Elastic limit per square inch of original section	do...	60,000
Elongation per inch after rupture	inch..	.190
Elongation per inch under strain at elastic limit	do...	.00215
Reduction in diameter at point of rupture	do...	.115
Reduction in area after rupture, per cent of original section		40.3
Position of rupture		".9 from the neck
Character of broken surface		silky
Elongation of inch sections		".11, ".27*

JACKET.

No. 8277.

Marks, $\frac{70751\ B_2}{BT_1M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00025	.00015	.....	.....	
30,000	.00080	.00055	.....	.....	
50,000	.00160	.00080	0.	.0	
55,000	.00180	.00020	.....	.....	
60,000	.00200	.00020	.....	.....	
65,000	.00220	.00020	.....	.....	
66,000	.00230	.00010	.....	.....	Elastic limit.
67,000	.00355	.00125	.....	.....	
68,000	.00750	.00395	.....	.....	
69,000	.00865	.00115	.....	.....	
109,500	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	109,500
Elastic limit per square inch of original section	do...	66,000
Elongation per inch after rupture	inch..	.175
Elongation per inch under strain at elastic limit	do...	.00230
Reduction in diameter at point of rupture	do...	.105
Reduction in area after rupture, per cent of original section		37.1
Position of rupture		".50 from the neck
Character of broken surface		silky
Elongation of inch sections		".24", ".11

JACKET.

No. 8281.

Marks, $\frac{70791\ B_2\ F_2}{BT_1O}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00030	.00015	.....	.....	
30,000	.00090	.00060	.....	.....	
50,000	.00150	.00060	0.	0.	
55,000	.00170	.00020	.....	.....	
60,000	.00190	.00020	.....	.....	
65,000	.00205	.00015	.....	.....	
66,000	.00210	.00005	.....	.....	
67,000	.00215	.00005	.....	.....	Elastic limit.
68,000	.00885	.00670	.....	.....	
69,000	.00990	.00105	.....	.....	
70,000	.01050	.00060	.....	.....	
71,000	.01130	.00080	.....	.....	
104,000	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	104,000
Elastic limit per square inch of original section	do...	67,000
Elongation per inch after rupture	inch..	.185
Elongation per inch under strain at elastic limit	do...	.00215
Reduction in diameter at point of rupture	do...	.105
Reduction in area after rupture, per cent of original section		37.1
Position of rupture		″.80 from the neck
Character of broken surface		silky, oblique
Elongation of inch sections		″.24[8], ″.13

LOCKING HOOP.

No. 8195.

Marks, $\frac{59177\ B_1\ F_1}{BT_2M}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00030	.00020	.....	.....	
30,000	.00090	.00060	.....	.....	
40,000	.00125	.00035	.....	.....	
50,000	.00160	.00035	0.	0.	
55,000	.00175	.00015	.....	.....	
58,000	.00185	.00010	.....	.....	
59,000	.00190	.00005	.....	.....	Elastic limit.
60,000	.00480	.00290	.....	.....	
61,000	.00680	.00200	.....	.....	
62,000	.00740	.00060	.....	.....	
63,000	.00820	.00080	.....	.....	
64,000	.00885	.00065	.....	.....	
103,500	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	103,500
Elastic limit per square inch of original section	do...	59,000
Elongation per inch after rupture	inch..	.210
Elongation per inch under strain at elastic limit	do...	.00190
Reduction in diameter at point of rupture	do...	.115
Reduction in area after rupture, per cent of original section		40.3
Position of rupture		1″ from the neck
Character of broken surface		silky
Elongation of inch sections		″.15, ″.27*

LOCKING HOOP.

No. 8206.

Marks, $\frac{59174\ B_1F_1}{BT_AM}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00030	.00015	.....	.....	
30,000	.00085	.00055	.....	.....	
50,000	.00155	.00070	0.	0.	
55,000	.00170	.00015	.....	.....	
58,000	.00185	.00015	.....	.....	Elastic limit.
59,000	.00300	.00115	.....	.....	
60,000	.00585	.00285	.....	.....	
61,000	.00710	.00125	.....	.....	
62,000	.00815	.00105	.....	.....	
98,500	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	98,500
Elastic limit per square inch of original section	do...	58,000
Elongation per inch after rupture	inch..	.240
Elongation per inch under strain at elastic limit	do...	.00185
Reduction in diameter at point of rupture	do...	.145
Reduction in area after rupture, per cent of original section		49.1
Position of rupture		1″ from the neck
Character of broken surface		silky
Elongation of inch sections		″.16, ″.32*

BREECHBLOCK.

No. 8192.

Marks, $\frac{63303\ B_2F_{18}}{T_1M}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
30,000	.00095	.00080	.....	.....	
40,000	.00125	.00030	.....	.....	
50,000	.00165	.00040	0.	0.	
55,000	.00180	.00015	.....	.....	
60,000	.00195	.00015	.....	.....	
65,000	.00215	.00020	.....	.....	
70,000	.00235	.00020	.....	.....	
72,000	.00250	.00015	.....	.....	Elastic limit.
73,000	.00290	.00040	.....	.....	
74,000	.00490	.00200	.....	.....	
75,000	.00600	.00110	.....	.....	
76,000	.00730	.00130	.....	.....	
77,000	.00840	.00110	.....	.....	
112,500	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	112,500
Elastic limit per square inch of original section	do...	72,000
Elongation per inch after rupture	inch..	.17
Elongation per inch under strain at elastic limit	do...	.00250
Reduction in diameter at point of rupture	do...	.085
Reduction in area after rupture, per cent of original section		30.7
Position of rupture		″.60 from the neck
Character of broken surface		silky
Elongation of inch sections		″.24*, ″.10

BREECHBLOCK.

No. 8194.

Marks, $\frac{63304\ B_1\ F_{20}}{T_1M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
30,000	.00080	.00070	.....	.....	
40,000	.00110	.00030	.....	.....	
50,000	.00145	.00035	0.	0.	
55,000	.00160	.00015	.....	.....	
60,000	.00185	.00025	.....	.....	
65,000	.00200	.00015	.....	.....	
70,000	.00220	.00020	.....	.....	Elastic limit.
71,000	.00510	.00290	.....	.....	
72,000	.00850	.00340	.....	.....	
73,000	.00930	.00080	.....	.....	
74,000	.01025	.00095	.....	.....	
75,000	.01175	.00150	.....	.....	
109,500	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	109,500
Elastic limit per square inch of original section	do...	70,000
Elongation per inch after rupture	inch..	.185
Elongation per inch under strain at elastic limit	do...	.00220
Reduction in diameter at point of rupture	do...	.105
Reduction in area after rupture, per cent of original section		37.1
Position of rupture		1" from the neck
Character of broken surface		silky
Elongation of inch sections		".22*, ".15

BREECHBLOCK.

No. 8197.

Marks, 49–5.
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00020	.00010			
30,000	.00085	.00065			
40,000	.00125	.00040			
50,000	.00160	.00035	0.	0.	
55,000	.00175	.00015			
60,000	.00190	.00015			
64,000	.00205	.00015			Elastic limit.
65,000	.00220	.00015			
66,000	.00275	.00055			
67,000	.00325	.00050			
68,000	.00435	.00110			
69,000	.00620	.00185			
102,000					Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	102,000
Elastic limit per square inch of original section	do...	64,000
Elongation per inch after rupture	inch..	.155
Elongation per inch under strain at elastic limit	do...	.00205
Reduction in diameter at point of rupture	do...	.085
Reduction in area after rupture, per cent of original section		30.7
Position of rupture		at middle of stem
Character of broken surface		silky, serrated
Elongation of inch sections		″.14*, ″.17*

BREECHBLOCK.

No. 8201.

Marks, 49–5.
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00030	.00020	.....	.....	
30,000	.00105	.00075	.....	.....	
40,000	.00140	.00035	.....	.....	
45,000	.00155	.00015	.....	.....	
50,000	.00175	.00020	.....	.....	
55,000	.00195	.00020	.....	.....	
60,000	.00215	.00020	.....	.....	
65,000	.00240	.00025	.....	.....	
70,000	.00255	.00015	.....	.....	
75,000	.00270	.00015	.....	.....	
80,000	.00290	.00020	.....	.....	
85,000	.00310	.00020	.....	.....	
90,000	.00335	.00025	.....	.....	
94,000	.00350	.00015	.....	.....	Elastic limit.
95,000	.00365	.00015	.....	.....	
96,000	.00380	.00015	.....	.....	
97,000	.00425	.00045	.....	.....	
98,000	.00525	.00100	.....	.....	
123,000	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	123,000
Elastic limit per square inch of original section	do...	94,000
Elongation per inch after rupture	inch..	.115
Elongation per inch under strain at elastic limit	do...	.00350
Reduction of diameter at point of rupture	do...	.065
Reduction in area after rupture, per cent of original section		24
Position of rupture		″.9 from the neck
Character of broken surface		silky, serrated, oblique
Elongation of inch sections		″.16*, ″.07

BREECHBLOCK.

No. 8215.

Marks, $\frac{63305\ B_2\ F_{28}}{T_1M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00030	.00020	.....	.....	
30,000	.00100	.00070	.....	.....	
50,000	.00165	.00065	0.	0.	
55,000	.00180	.00015	.....	.....	
60,000	.00195	.00015	.....	.....	
65,000	.00210	.00015	.....	.....	
70,000	.00230	.00020	.....	.....	
72,000	.00235	.00005	.....	.....	Elastic limit.
73,000	.00245	.00010	.....	.....	
74,000	.00290	.00045	.....	.....	
75,000	.00375	.00085	.....	.....	
76,000	.00420	.00045	.....	.....	
77,000	.00510	.00090	.....	.....	
114,000	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	114,000
Elastic limit per square inch of original section	do...	72,000
Elongation per inch after rupture	inch..	.195
Elongation per inch under strain at elastic limit	do...	.00235
Reduction in diameter at point of rupture	do...	.105
Reduction in area after rupture, per cent of original section		37.1
Position of rupture		at the middle of the stem
Character of broken surface		silky
Elongation of inch sections		".19*, ".20*

BREECH BUSHING.

No. 8214.

Marks, $\frac{63307\ B_1\ F_{10}}{T_2M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00035	.00020	.....	.....	
30,000	.00115	.00080	.....	.....	
50,000	.00175	.00060	0.	0.	
55,000	.00195	.00020	.....	.....	
60,000	.00215	.00020	.....	.....	
65,000	.00230	.00015	.....	.....	
70,000	.00250	.00020	.....	.....	
71,000	.00260	.00010	.....	.....	Elastic limit.
72,000	.00280	.00020	.....	.....	
73,000	.00305	.00025	.....	.....	
74,000	.00335	.00030	.....	.....	
75,000	.00370	.00035	.....	.....	
76,000	.00425	.00055	.....	.....	
114,500	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	114,500
Elastic limit per square inch of original section	do...	71,000
Elongation per inch after rupture	inch..	.180
Elongation per inch under strain at elastic limit	do...	.00260
Reduction in diameter at point of rupture	do...	.095
Reduction in area after rupture, per cent of original section		34
Position of rupture		".9 from the neck
Character of broken surface		silky, oblique
Elongation of inch sections		".24*, ".12

TABULATION OF TENSION SPECIMENS FROM 3-INCH R. F. GUNS.

STEMS, 2" LONG; ".505 DIAMETER.

No. of test.	Position in gun.	Location of specimens.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Appearance of fracture.	Remarks.
			Pounds.	*Pounds.*	*Per ct.*	*Per ct.*		
8191	Tube...	Middle.	67,000	108,500	18.5	40.3	Silky	Breech end.
8196	....do...	...do...	67,000	110,500	18.0	34.0	Silky; oblique	Do.
8200	....do...	...do...	65,000	112,500	19.0	34.0	Silky	Do.
8203	....do...	...do...	65,000	109,000	18.5	34.0	.....do	Do.
8204	....do...	...do...	64,000	106,000	17.0	30.7	.....do	Do.
8207	....do...	...do...	70,000	112,000	17.0	37.1	.....do	Do.
8210	....do...	...do...	70,000	107,500	20.5	43.3	.....do	Do.
8211	....do...	...do...	72,000	114,500	17.5	34.0	.....do	Do.
8212	....do...	.....	65,000	109,500	20.0	40.3	.....do	Do.
8218	....do...	Middle.	72,000	113,000	18.0	34.0	.....do	Do.
8263	....do...	...do...	70,000	112,000	20.0	43.3	.....do	Do.
8267	....do...	Outside	69,000	113,500	19.0	40.3	.....do	Do.
8271	....do...	Middle.	63,000	106,000	19.5	37.1	.....do	Do.
8278	....do...	...do...	67,000	114,000	17.0	37.1	.....do	Do.
8280	....do...	...do...	66,000	112,500	20.0	40.3	.....do	Do.
8193	Jacket..	...do...	69,000	115,500	15.5	30.7	Silky, 55 per cent; granular, 45 per cent.	Do.
8198	....do...	...do...	70,000	110,500	17.5	27.4	Silky	Do.
8199	....do...	...do...	67,000	103,000	15.5	23.9	.....do	Do.
8202	....do...	...do...	64,000	106,500	19.0	34.0	Silky; oblique	Do.
8205	....do...	...do...	60,000	103,000	16.5	34.0	Silky	Do.
8208	....do...	.....	62,000	99,500	21.5	46.2	.....do	
8209	....do...	Middle.	70,000	112,000	18.5	37.1	.....do	Do.
8213	....do...	...do...	64,000	107,000	15.0	37.1	Silky; oblique	Do.
8217	....do...	...do...	71,000	117,000	15.5	30.7	Silky; trace of granulation.	Do.
8219	....do...	...do...	64,000	107,000	18.0	30.7	Silky; in part granular.	Do.
8220	....do...	.....	65,000	106,000	20.0	49.1	Silky	
8268	....do...	Middle.	69,000	110,500	19.0	37.1	.....do	Do.
8269	....do...	...do...	62,000	104,000	20.0	46.2	.....do	Do.
8270	....do...	...do...	71,000	104,500	19.5	37.1	.....do	Muzzle end.
8273	....do...	...do...	68,000	107,000	20.5	40.3	.....do	Do.
8274	....do...	...do...	69,000	106,000	16.0	24.0	.....do	Do.
8275	....do...	...do...	60,000	104,500	19.0	40.3	.....do	Breech end.
8277	....do...	...do...	66,000	109,500	17.5	37.1	.....do	Do.
8281	....do...	Outside	67,000	104,000	18.5	37.1	Silky; oblique	Do.
8195	Locking hoop.	Middle.	59,000	103,500	21.0	40.3	Silky	Do.
8206	....do...	...do...	58,000	98,500	24.0	49.1	.....do	Do.
8192	Breech-block.	...do...	72,000	112,500	17.0	30.7	.....do	
8194	....do...	...do...	70,000	109,500	18.5	37.1	.....do	
8197	....do...	.....	64,000	102,000	15.5	30.7	Silky; serrated	
8202	....do...	.....	94,000	123,000	11.5	24.0	Silky; serrated; oblique.	
8215	....do...	Middle.	72,000	114,000	19.5	37.1	Silky	
8214	Breech bushing.	...do...	71,000	114,500	18.0	34.0	Silky; oblique	

6-INCH R. F. GUNS.

SPECIMENS FROM TUBE, JACKETS, HOOP, BREECH BUSHING, AND SPINDLE.

TUBE.

No. 8279.

Marks, $\frac{70435\ B_1}{BT_2M}$
Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 2″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00025	.00015	.....	.....	
30,000	.00075	.00050	.....	.....	
50,000	.00145	.00070	−.00005	−.00005	
54,000	.00155	.00010	.....	.....	Elastic limit.
55,000	.00350	.00195	.....	.....	
57,000	.00405	.00055	.....	.....	
58,000	.00760	.00355	.....	.....	
98,500	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	98,500
Elastic limit per square inch of original section	do...	54,000
Elongation per inch after rupture	inch..	.220
Elongation per inch under strain at elastic limit	do...	.00155
Reduction in diameter at point of rupture	do...	.105
Reduction in area after rupture, per cent of original section		37.1
Position of rupture		1″.12 from the neck
Character of broken surface		silky; trace of granulation
Elongation of inch sections		″.28*, ″.16

JACKET.

No. 8264.

Marks, $\frac{6RF\ 3J}{BT_1O}$
Diameter, ″.564.
Sectional area, .25 square inch.
Gauged length, 3″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.000100	.000100	0.	0.	
10,000	.000300	.000200	.....	.....	
30,000	.001000	.000700	.....	.....	
40,000	.001333	.000333	.....	.....	
45,000	.001500	.000167	.....	.....	
50,000	.001667	.000167	0.	0.	
55,000	.001800	.000133	.....	.....	
60,000	.002000	.000200	.....	.....	
61,000	.002033	.000033	.....	.....	Elastic limit.
62,000	.003167	.001134	.....	.....	
63,000	.006333	.003166	.....	.....	
64,000	.007233	.000900	.....	.....	
101,600	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	101,600
Elastic limit per square inch of original section	do...	61,000
Elongation per inch after rupture	inch..	.177
Elongation per inch under strain at elastic limit	do...	.002033
Reduction in diameter at point of rupture	do...	.134
Reduction in area after rupture, per cent of original section		41.9
Position of rupture		1″.10 from the neck
Character of broken surface		silky
Elongation of inch sections		″.28*, ″.15, ″.10

JACKET.

No. 8265.

Marks, $\frac{6RF\ SJ}{BT_1\ O}$
Diameter, ″.564.
Sectional area, .25 square inch.
Gauged length, 3″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.000133	.000133	0.	0.	
10,000	.000300	.000167	.....	.....	
30,000	.000933	.000633	.....	.....	
40,000	.001300	.000367	.....	.....	
50,000	.001633	.000333	−.000033	−.000033	
55,000	.001800	.000167	.....	.....	
60,000	.002000	.000200	.....	.....	
61,000	.002033	.000033	.....	.....	Elastic limit.
62,000	.002200	.000167	.....	.....	
63,000	.002600	.000400	.....	.....	
64,000	.003133	.000533	.....	.....	
65,000	.004000	.000867	.....	.....	
108,000	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	108,000
Elastic limit per square inch of original section	do...	61,000
Elongation per inch after rupture	inch..	.150
Elongation per inch under strain at elastic limit	do...	.002033
Reduction in diameter at point of rupture	do...	.134
Reduction in area after rupture, per cent of original section		41.9
Position of rupture		1″.08 from the neck
Character of broken surface		silky
Elongation of inch sections		″.07, ″.10, ″.28*

JACKET.

No. 8266.

Marks, $\frac{6RF\ 7J}{MT_1I}$
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.000133	.000133	0.	0.	
10,000	.000267	.000134	.....	.....	
30,000	.000900	.000633	.....	.....	
40,000	.001267	.000367	.....	.....	
50,000	.001633	.000366	−.000100	−.000100	
55,000	.001800	.000167	.....	.....	
60,000	.001967	.000167	.....	.....	
61,000	.002033	.000066	.....	.....	Elastic limit.
62,000	.002233	.000200	.....	.....	
63,000	.002867	.000634	.....	.....	
64,000	.004167	.001300	.....	.....	
65,000	.006500	.002333	.....	.....	
102,400	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	102,400
Elastic limit per square inch of original section	do...	61,000
Elongation per inch after rupture	inch..	.147
Elongation per inch under strain at elastic limit	do...	.002033
Reduction in diameter at point of rupture	do...	.094
Reduction in area after rupture, per cent of original section		30.6
Position of rupture		".80 from the neck
Character of broken surface		granular; belt of silky metal across fractured surface
Elongation of inch sections		".25*, ".11, ".08

JACKET.

No. 8282.

Marks, $\frac{69378\ B_4}{BT_2M}$
Diameter, ".564.
Sectional area, .25.square inch.
Gauged length, 3".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.000167	.000167	0.	0.	
10,000	.000333	.000166	.....	.....	
30,000	.001100	.000767	.....	.....	
40,000	.001433	.000333	.....	.....	
50,000	.001667	.000234	0.	0.	
54,000	.001867	.000200	.....	.....	Elastic limit.
55,000	.004667	.002800	.....	.....	
56,000	.010667	.006000	.....	.....	
57,000	.011933	.001266	.....	.....	
58,000	.012833	.000900	.....	.....	
91,200	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	91,200
Elastic limit per square inch of original section	do...	54,000
Elongation per inch after rupture	inch..	.197
Elongation per inch under strain at elastic limit	do...	.001867
Reduction in diameter at point of rupture	do...	.114
Reduction in area after rupture, per cent of original section		36.4
Position of rupture		1".05 from the neck
Character of broken surface		silky
Elongation of inch sections		".23", ".20, ".16

C1 Hoop.

No. 8272.

Marks, $\frac{6RF\,6C1}{MT_3M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00025	.00015	.....	.....	
30,000	.00100	.00075	.....	.....	
50,000	.00170	.00070	0.	0.	
55,000	.00180	.00010	.....	.....	
60,000	.00200	.00020	.....	.....	
63,000	.00215	.00015	.....	.....	Elastic limit.
64,000	.00775	.00560	.....	.....	
65,000	.00835	.00060	.....	.....	
66,000	.00950	.00115	.....	.....	
99,500	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	99,500
Elastic limit per square inch of original section	do...	63,000
Elongation per inch after rupture	inch..	.200
Elongation per inch under strain at elastic limit	do...	.00215
Reduction in diameter at point of rupture	do...	.105
Reduction in area after rupture, per cent of original section		40.3
Position of rupture		".9 from the neck
Character of broken surface		silky
Elongation of inch sections		".27",".13

BREECH BUSHING.

No. 8276.

Marks, $^{6RF\ 13BU}_{T_1M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00020	.00010	.....	.....	
30,000	.00080	.00060	.....	.....	
50,000	.00150	.00070	0.	0.	
55,000	.00165	.00015	.....	.....	
60,000	.00180	.00015	.....	.....	
65,000	.00195	.00015	.....	.....	
70,000	.00220	.00025	.....	.....	
75,000	.00240	.00020	.....	.....	
80,000	.00250	.00010	.....	.....	
85,000	.00265	.00015	.....	.....	
90,000	.00285	.00020	.....	.....	
95,000	.00305	.00020	.....	.....	
100,000	.00320	.00015	.....	.....	
109,000	.00360	.00040	.....	.....	Elastic limit.
110,000	.00395	.00035	.....	.....	
111,000	.00445	.00050	.....	.....	
112,000	.00630	.00185	.....	.....	
130,500	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	130,500
Elastic limit per square inch of original section	do...	109,000
Elongation per inch after rupture	inch..	.180
Elongation per inch under strain at elastic limit	do...	.00360
Reduction in diameter at point of rupture	do...	.185
Reduction in area after rupture, per cent of original section		59.8
Position of rupture		1".03 from the neck
Character of broken surface		fine silky
Elongation of inch sections		".28* "08

SPINDLE.

No. 8216.

Marks, $\frac{40355\ B_1F_9}{L}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00020	.00020	0.	0.	
10,000	.00030	.00010	.....	.....	
30,000	.00100	.00070	.....	.....	
50,000	.00170	.00070	0.	0.	
55,000	.00185	.00015	.....	.....	
60,000	.00200	.00015	.....	.....	
65,000	.00220	.00020	.....	.....	
70,000	.00240	.00020	.....	.....	
75,000	.00255	.00015	.....	.....	
80,000	.00275	.00020	.....	.....	
85,000	.00295	.00020	.....	.....	
90,000	.00310	.00015	.....	.....	
100,000	.00350	.00040	.....	.....	
110,000	.00395	.00045	.....	.....	
116,000	.00435	.00040	.....	.....	
117,000	.00455	.00020	.....	.....	
118,000	.00475	.00020	.....	.....	
119,000	.00490	.00015	.....	.....	
120,000	.00500	.00010	.....	.....	
121,000	.00510	.00010	.....	.....	Elastic limit.
122,000	.00530	.00020	.....	.....	
123,000	.00560	.00030	.....	.....	
124,000	.00575	.00015	.....	.....	
125,000	.00600	.00025	.....	.....	
126,000	.00635	.00035	.....	.....	
127,000	.00675	.00040	.....	.....	
128,000	.00710	.00035	.....	.....	
158,000	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	158,000
Elastic limit per square inch of original section	do...	121,000
Elongation per inch after rupture	inch..	.130
Elongation per inch under strain at elastic limit	do...	.00510
Reduction in diameter at point of rupture	do...	.085
Reduction in area after rupture, per cent of original section		30.7
Position of rupture		1" from the neck
Character of broken surface		silky
Elongation of inch sections		"10,"16*

TABULATION OF TENSION SPECIMENS FROM 6-INCH R. F. GUNS.

STEMS 3″ LONG; ″.564 DIAMETER.

No. of test.	Position in gun.	Location of specimens.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Appearance of fracture.	Remarks.
			Pounds	*Pounds.*	*Per ct.*	*Per ct.*		
8279	Tube...	Middle..	54,000	98,500	22.0	37.1	Silky; trace of granulation.	Breech end.
8264	Jacket..	Outside.	61,000	101,600	17.7	41.9	Silky.....	Do.
8265	....do...	....do...	61,000	108,000	15.0	41.9	.....do.....	Do.
8266	....do...	Inside ..	61,000	102,400	14.7	30.6	Granular; silky band.	Muzzle end.
8282	....do...	Middle..	54,000	91,200	19.7	36.4	Silky.....	Breech end.

STEMS 2″ LONG; ″.505 DIAMETER.

8272	Hoop...	Middle..	63,000	99,500	20.0	40.3	Silky.....	Muzzle end.
8276	Breech bushing.	....do...	109,000	130,500	18.0	59.8	Fine silky.....	
8216	Spindle.	.....	121,000	158,000	13.0	30.7	Silky.....	

MANDREL TESTS

OF RINGS FROM TUBES AND JACKETS.

MANDREL TESTS OF SLICES TAKEN FROM TUBES AND JACKETS OF 3-INCH RIFLES.

TUBE SLICES.

Slices when received had inside diameter of about 2″.90; bored to 2″.90.

Outside diameters, 5″.22 to 5″.79 each.

Lengths, 0″.99 to 1″.22.

General marks, 3R — T.

No. of ring.	Original interior dimensions.		Interior circumference after rupture.	Interior circumferential extension.		Rupture of ring began at—	Description of fracture.
	Diameter.	Circumference.					
	In.	*In.*	*In.*	*In.*	*Per ct.*		
70	2.90	9.11	11.66	2.55	28.0	Inside.....	Lamellar, 85 per cent; granular, 15 per cent.
71	2.90	9.11	12.05	2.91	31.9	.....do.....	Do.
72	2.90	9.11	11.40	2.29	25.1	Outside.....	Do.
73	2.90	9.11	11.78	2.67	29.3	.....do.....	Lamellar; 1 crack at outside.
74	2.90	9.11	12.02	2.91	31.9	.....do.....	Granular.
75	2.90	9.11	10.73	1.62	17.8	.....do.....	Granular; 1 crack at outside.
76	2.90	9.11	11.57	2.46	27.0	.....do.....	Granular; 2 cracks at outside.
77	2.90	9.11	11.87	2.76	30.3	.....do.....	Lamellar, 30 per cent; granular, 70 per cent.
78	2.90	9.11	12.45	3.34	36.7	Inside.....	Granular; oblique; 2 cracks at inside.
79	2.90	9.11	12.00	2.89	31.7	Outside.....	Granular; oblique; 3 cracks at outside.
80	2.90	9.11	12.08	2.97	32.6	.....do.....	Lamellar; 2 cracks at outside.
81	2.90	9.11	11.35	2.24	24.6	.....do.....	Lamellar, 40 per cent; granular, 60 per cent.
82	2.90	9.11	12.07	2.96	32.5	.....do.....	Lamellar, 40 per cent; granular, 60 per cent; 1 crack at outside.
83	2.90	9.11	11.67	2.56	28.1	Inside.....	Lamellar.
84	2.90	9.11	11.93	2.82	31.0	.....do.....	Do.
85	2.90	9.11	11.36	2.25	24.7	Outside.....	Granular.
87	2.90	9.11	11.56	2.45	26.9	.....do.....	Do.
88	2.90	9.11	12.13	3.02	33.1	Inside.....	Lamellar, 50 per cent; granular, 50 per cent.
89	2.90	9.11	12.10	2.99	32.8	Outside.....	Oblique, lamellar, 60 per cent; granular, 40 per cent.
90	2.90	9.11	11.57	2.46	27.0	.....do.....	Granular.
91	2.90	9.11	11.46	2.35	25.8	.....do.....	Do.
93	2.90	9.11	11.72	2.61	28.6	.....do.....	Do.
94	2.90	9.11	11.76	2.65	29.1	.....do.....	Lamellar, 60 per cent; granular, 40 per cent; 1 crack at outside.
95	2.90	9.11	12.05	2.94	32.3	.....do.....	Lamellar, 20 per cent; granular, 80 per cent.
96	2.90	9.11	11.72	2.61	28.6	.....do.....	Granular.
97	2.90	9.11	11.58	2.47	27.1	Inside.....	Lamellar, 20 per cent; granular, 80 per cent.
98	2.90	9.11	12.08	2.97	32.6	Outside.....	Lamellar; 1 crack at outside.
98	2.90	9.11	11.90	2.79	30.6	.....do.....	Granular.
99	2.90	9.11	11.62	2.51	27.5	Inside.....	Lamellar, 30 per cent; granular, 70 per cent.
100	2.90	9.11	11.95	2.84	31.2	.....do.....	Do.
101	2.90	9.11	11.47	2.36	25.9	Outside.....	Granular; 1 crack at outside.
102	2.90	9.11	11.69	2.58	28.3	.....do.....	Granular.
103	2.90	9.11	11.63	2.52	27.7	Inside.....	Lamellar, 50 per cent; granular, 50 per cent.
104	2.90	9.11	12.28	3.17	34.8	Outside.....	Granular.
105	2.90	9.11	11.67	2.56	28.1	.....do.....	Do.
106	2.90	9.11	12.02	2.91	31.9	Inside.....	Lamellar; 2 cracks each at outside and inside.
108	2.90	9.11	11.72	2.61	28.6	.....do.....	Lamellar.
109	2.90	9.11	11.75	2.64	29.0	.....do.....	Do.

JACKET SLICES.

[Slices bored to 5".02 diameter=15".77 circumference of bore, for mandrel test.]

No. of ring.	Original interior dimensions.		Interior circumference after rupture.	Interior circumferential extension.		Rupture of ring began at—	Description of fracture.
	Diameter.	Circumference.					
	In.	*In.*	*In.*	*In.*	*Per ct.*		
67	5.02	15.77	19.38	3.61	22.8	Outside.....	Granular.
68	5.02	15.77	19.60	3.83	24.2	.....do.....	Do.
69	5.02	15.77	19.10	3.33	21.1	.....do.....	Do.
70	5.02	15.77	19.50	3.73	23.6	.....do.....	Do.
71	5.02	15.77	19.20	3.43	21.1	.....do.....	Do.
72	5.02	15.77	18.93	3.16	20.0	.....do.....	Granular; 3 cracks at inside.
73	5.02	15.77	17.96	2.19	13.8	Inside.....	Oblique, lamellar, 50 per cent; granular, 50 per cent.
74	5.02	15.77	18.55	2.78	17.6	.....do.....	Lamellar, 40 per cent; granular, 60 per cent.
75	5.02	15.77	18.67	2.90	18.3	Outside.....	Granular; crack at inside.
76	5.02	15.77	20.36	4.59	29.1	Not fractured.	Mandrel passed through.
77	5.02	15.77	19.50	3.73	23.6	Inside.....	Lamellar, 30 per cent; granular, 70 per cent.
78	5.02	15.77	18.51	2.74	17.3	.....do.....	Lamellar, 20 per cent; granular, 80 per cent; 1 crack at inside.
79	5.02	15.77	19.35	3.58	22.7	.....do.....	Lamellar, 25 per cent; granular, 75 per cent.
80	5.02	15.77	19.71	3.94	24.9	.....do.....	Lamellar, 15 per cent; granular, 85 per cent; 1 crack at inside.
81	5.02	15.77	19.09	3.32	21.0	Outside.....	Lamellar, 60 per cent; granular, 40 per cent.
82	5.02	15.77	19.55	3.78	23.9	.....do.....	Granular; 1 crack at inside.
83	5.02	15.77	18.25	2.48	15.7	Inside.....	Lamellar, 25 per cent; granular, 75 per cent.
84	5.02	15.77	19.37	3.60	22.8	.....do.....	Lamellar, 50 per cent; granular, 50 per cent; 5 cracks at inside.
85	5.02	15.77	19.86	4.09	25.9	.....do.....	Lamellar, 30 per cent; granular, 70 per cent.
86	5.02	15.77	17.21	1.44	9 1	.....do.....	Lamellar, 30 per cent; granular, 70 per cent; 15 small cracks at inside.
87	5.02	15.77	19.82	4.05	25.6	.....do.....	Lamellar, 50 per cent; granular, 50 per cent; 2 cracks at outside.
88	5.02	15.77	20.02	4.25	26.9	.....do.....	Silky, 20 per cent; granular, 80 per cent.
89	5.02	15.77	19.42	3.65	23.1	Outside.....	Granular.
89	5.02	15.77	19.49	3.72	23.5	Inside.....	Lamellar, 25 per cent; granular, 75 per cent.
90	5.02	15.77	19.32	3.55	22.5	.....do.....	Lamellar, 75 per cent; granular, 25 per cent.
91	5.02	15.77	19.05	3.28	20.7	.....do.....	Granular; 2 cracks at inside.
92	5.02	15.77	17.70	1.93	12.2	Outside.....	Granular; 1 crack at inside.
93	5.02	15.77	19.12	3.35	21.2	Inside.....	Lamellar, 20 per cent; granular, 80 per cent.
94	5.02	15.77	19.25	3.48	22.0	.....do.....	Lamellar, 15 per cent; granular, 85 per cent; 3 cracks at inside.
94	5.02	15.77	18.90	3.13	19.8	Outside.....	Granular.
95	5.02	15.77	19.12	3.35	21.2	.....do.....	Do.
96	5.02	15.77	18.86	3.09	19.5	.....do.....	Do.
97	5.02	15.77	19.68	3.91	24.7	.....do.....	Do.
98	5 02	15.77	18.70	2.93	18.5	.....do.....	Do.
99	5.02	15.77	19.21	3.44	21.8	Inside.....	Lamellar, 15 per cent; granular, 85 per cent.
100	5.02	15.77	19.37	3.60	22.8	Outside.....	Granular.
101	5.02	15.77	18.81	3.04	19.2	Inside.....	Do.
101	5.02	15.77	18.94	3.17	20.1	.....do.....	Granular; 4 cracks at inside.
102	5.02	15.77	18.35	2.58	16.3	Outside.....	Granular.
103	5.02	15.77	18.80	3.03	19.2	.....do.....	Do.
105	5.02	15.77	18.80	3.03	19.2	.....do.....	Lamellar, 10 per cent; granular, 90 per cent; 1 crack at inside.

ADDITIONAL RINGS.

No. of ring.	Original interior dimensions.		Interior circumference after rupture.	Interior circumferential extension.		Rupture of ring began at—	Description of fracture.
	Diameter.	Circumference.					
	In.	*In.*	*In.*	*In.*	*Per ct.*		
3R92J	4.92	15.46	18.28	2.82	18.2	2 places.....	1 fracture started at inside; granular. Other fracture started at silky spot on side; granular, 80 per cent; silky, 20 per cent.
3R106J	4.92	15.46	19.81	4.35	28.1	Inside.....	Lamellar.
3R110T	3.00	9.42	11.88	2.46	26.1	Center.....	Granular, 75 per cent; dull, smooth spot, 25 per cent.
3.8R1T	3.74	11.75	13.29	1.54	13.1	Not fractured.	Mandrel passed through.
3.8R1J	5.90	18.54	20.36	1.82	9.8	.....do.....	Do.

RINGS MADE AT WATERTOWN ARSENAL SMITH SHOP.

1	3.00	9.42	12.71	3.29	34.9	Inside.....	Silky.
2	3.00	9.42	12.75	3.33	35.4	Outside.....	Silky; irregular; 1 crack at outside.
3	3.00	9.42	12.82	3.40	36.1	Inside.....	Silky; oblique.
4	3.00	9.42	12.91	3.49	37.0	.....do.....	Do.
5	5.17	16.24	20.30	4.06	25.0	.....do.....	Silky.
6	5.17	16.24	19.50	3.26	20.1	At spot on side.	Granular.
7	5.17	16.24	19.25	3.01	18.5	.....do.....	Do.
8	5.17	16.24	19.75	3.50	21.6	At silky spot inside.	Granular, 80 per cent; silky, 20 per cent.

ADDITIONAL RINGS FROM WATERVLIET ARSENAL.

3R121T	2.94	9.24	12.46	3.22	34.8	.....	Granular, silky; serrated next bore.
3R122T	2.94	9.24	12.45	3.21	34.7	.....	Granular; silky at bore.
3R125T	2.94	9.24	12.37	3.13	33.9	.....	Granular, silky; serrated at bore.
3R126T	2.94	9.24	12.10	2.86	31.0	.....	Granular; radiating from exterior corner.
3R128T	2.94	9.24	12.56	3.32	35.9	.....	Silky, oblique.
3R122J	4.98	15.65	19.90	4.25	27.2	.....	Granular; silky next bore.
3R123J	4.98	15.65	20.36	4.71	30.1	.....	Passed over mandrel without rupturing.

TENSILE TESTS OF TANGENTIAL SPECIMENS REPRESENTING METAL IN 8 MANDREL TEST RINGS.

Diameter.	Sectional area.	Elastic limit.		Tensile strength.		Elongation in 2 inches.		Diameter at fracture.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
		Total.	Per square inch.	Total.	Per square inch.						
Inch.	*Sq. in.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Inch.*	*P. ct.*	*Inch.*	*P. ct.*	" "	
.505	.20	12,000	60,000	19,000	95,000	.45	22.5	.36	49.1	.11, .34*	Fine silky.
.505	.20	21,100	60,500	19,000	95,000	.51	25.5	.35	51.9	.36*, .15	Do.

TENSION TESTS OF TANGENTIAL SPECIMENS FROM TUBE OF 8-INCH RIFLE NO. 1.

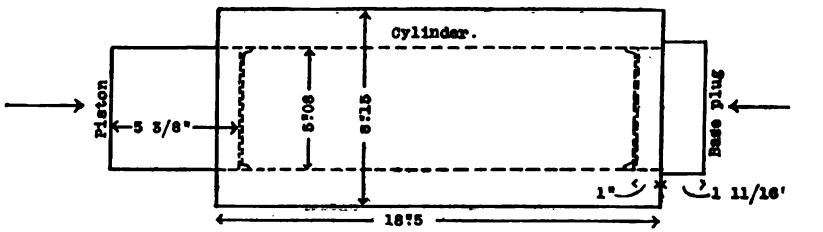
[Specimens taken out of rifle after gun was unserviceable at end of three hundred and eighty-eighth round.]

Specimen taken out.	Diameter.	Sectional area.	Elastic limit.		Tensile strength.		Elongation.		Diameter at fracture.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
			Total.	Per square inch.	Total.	Per square inch.						
	Inch.	*Sq. in.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Inch.*	*Per ct.*	*Inch.*	*Per ct.*	" " "	
8 feet from muzzle...	.564	.25	12,400	49,600	23,600	94,400	.60	20.0	.46	33.5	.14, .19, .27*	Silky, 60 per cent; granular, 40 per cent.
Do.....	.564	.25	12,000	48,000	24,000	93,600	.61	20.3	.47	30.6	.29*, .17, .15	Silky, 50 per cent; granular, 50 per cent.
At muzzle.....	.505	.20	9,600	48,000	18,400	92,000	.42	21.0	.42	30.7	.27*, .15	Granular; silky, flaky metal.
Do.....	.505	.20	9,500	47,500	18,500	92,500	.45	22.5	.40	37.1	.25*, .20	Silky; trace of granulation.

HYDROSTATIC TEST

OF EXPERIMENTAL 5-INCH TUBE.

HYDROSTATIC TEST OF EXPERIMENTAL 5-INCH TUBE.



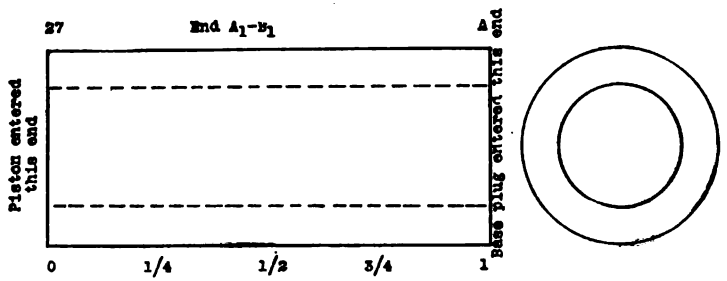
Sectional area of bore, 20.27 square inches.
Tangential stress at the bore computed by the formula,

$$\theta = \frac{4R_1^2 + 2R_0^2}{P \times 3(R_1^2 - R_0^2)}$$

Total load on piston.	Interior pressure per square inch.	Tangential stress at bore per square inch.	Exterior diametrical		Remarks.
			Expansion.	Set.	
Pounds.	*Pounds.*	*Pounds.*	*Inch.*	*Inch.*	
7,783.67	384.01	1,000	0.	0.	Initial load.
38,918.35	1,920.00	5,000	.0004	.....	
77,836.70	3,840.00	10,000	.0009	.....	
116,755.05	5,760.00	15,000	.0015	.....	
155,673.40	7,680.00	20,000	.0024	0.	
194,591.75	9,600.00	25,000	.0030	.....	
233,510.10	11,520.00	30,000	.0036	− .0001	
272,428.45	13,440.00	35,000	.0043	.....	
311,346.80	15,360.00	40,000	.0049	.....	
350,265.15	17,280.00	45,000	a.0050	.....	
389,183.50	19,200.00	50,000	a.0050	.....	
428,101.85	21,120.00	55,000	a.0050	.....	
467,020.20	23,040.00	60,000	a.0050	.....	
505,938.55	24,960.00	65,000	a.0060	.....	Elastic limit.
544,856.90	26,880.00	70,000	a.0154	.....	
583,775.25	28,800.00	75,000	a.0408	.....	
622,693.60	30,720.00	80,000	.....	.....	
.....	.....	70,000	.0659	.....	
.....	.....	40,000	.0613	.....	
.....	.....	15,000	.0568	.....	Hydostatic test discontinued. Piston removed.

a These figures represent the diametrical expansion of the tube after having been loaded as shown by the first three columns, and then released to 40,000 pounds per square inch tangential stress at the bore.

Measurements of bore after hydrostatic test.



Diameters measured in five places, and at right angles to each other at each place.

Diameter.	Measurements.	
	First.	At right angles to first.
	Inches.	*Inches.*
0	5.0780	5.0758
¼	5.1166	5.1094
½	5.1614	5.1487
¾	5.1528	5.1407
1	5.0771	5.0748

SHRAPNEL CASES.

TESTS OF 3-INCH SHRAPNEL CASES RECEIVED FROM FRANKFORD ARSENAL.

TESTS BY INTERIOR HYDROSTATIC PRESSURE.

FIRST CASE.

Exterior diameter of case turned to 2″.93.

Interior diameter of case bored to 2″.715 for a length of 5″.

Case entered testing cylinder 1″, leaving 4″ length of reduced thickness of walls exposed to the interior pressures of the test.

Sectional area of piston, 5.79 square inches.

Applied loads.			Exterior diameter of case.	Remarks.
Total on piston.	Interior pressure per square inch.	Fiber stress on case per square inch.		
Pounds.	*Pounds.*	*Pounds.*	*Inches.*	
0	0	0	2.93	
24,000	4,145	.....	2.93	
30,000	5,181	.....	2.94	
35,000	6,045	.....	2.94	
40,000	6,908	.....	2.95	
43,000	7,427	.....	2.95	
46,000	7,945	.....	2.98	
50,000	8,636	.....	3.02	
53,000	9,154	123,405	.....	Ultimate strength.

Case ruptured longitudinally, beginning at a place 3″ from the forward end.. The line of rupture extended through the wall to the forward end, and in the opposite direction to the end of the reduced part, where the fracture bifurcated and extended circumferentially partly around the case.

Appearance of fracture, fine granular.

SECOND CASE.

Dimensions same as first case.

Applied loads.			Exterior diameter of case.	Remarks.
Total on piston.	Interior pressure per square inch.	Fiber stress on case per square inch		
Pounds.	*Pounds.*	*Pounds.*	*Inches.*	
0	0	0	2.93	
24,000	4,145	.....	2.93	
30,000	5,181	.....	2.93	
35,000	6,045	.....	2.94	
40,000	6,908	.....	2.95	
43,000	7,427	.....	2.97	
46,000	7,945	.....	3.03	
48,300	8,342	112,459	.....	Ultimate strength.

Manner of fracture same as first case.

THIRD CASE.

Dimensions same as first case.

Applied loads.			Exterior diameter of case.	Remarks.
Total on piston.	Interior pressure per square inch.	Fiber stress on case per square inch		
Pounds.	*Pounds.*	*Pounds.*	*Inches.*	
0	0	0	2.93	
24,000	4,145	.....	2.94	
30,000	5,181	.....	2.94	
35,000	6,045	.....	2.95	
40,000	6,908	.....	2.96	
43,000	7,427	.....	2.99	
46,000	7,945	.....	3.02	
50,000	8,636	.....	3.17	
50,400	8,705	117,352	.....	Ultimate strength.

Manner of fracture same as first case.

FOURTH CASE.

Dimensions same as first case.

Applied loads.			Exterior diameter of case.	Remarks.
Total on piston.	Interior pressure per square inch.	Fiber stress on case per square inch		
Pounds.	*Pounds.*	*Pounds.*	*Inches.*	
0	0	0	2.93	
24,000	4,145	.....	2.93	
30,000	5,181	.....	2.94	
35,000	6,045	.....	2.94	
40,000	6,908	.....	2.95	
43,000	7,427	.....	2.96	
46,000	7,945	.....	2.97	
50,000	8,636	.....	3.03	
51,500	8,895	119,913	.....	Ultimate strength.

Manner of fracture same as first case.

TENSILE TESTS OF LONGITUDINAL SPECIMENS FROM SHRAPNEL CASES.

No. of case.	Dimensions.		Sectional area.	Approximate elastic limit per square inch.	Tensile strength per square inch.	Elongation in 3 inches.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Width.	Thickness.						" " "	
	Inch.	*Inch.*	*Sq. in.*	*Pounds.*	*Pounds.*	*Per ct.*	*Per ct.*		
1	.473	.126	.0596	98,990	Stem not fractured.		.....	.....	Tore out head in front of pin.
1	.472	.098	.0463	101,510	117,060	4.7	38.0	.12*, .01, .01	Silky in part granular.
2	.476	.099	.0471	101,910	121,440	8.7	39.1	.14*, .09, .03	Do.
2	.472	.099	.0467	98,500	120,030	7.3	29.8	.02, .16*, .04	Silky.
3	.476	.098	.0466	94,420	121,890	3.7	27.9	.10*, .01, 0.	Silky; in part granular.
3	.475	.101	.0480	100,000	126,040	3.3	30.0	.09*, .01, 0.	Do.
4	.476	.101	.0481	101,870	128,900	4.7	38.9	.11*, .02, .01	Do.
4	.473	.102	.0482	103,730	127,590	4.7	39.0	.10*, .02, .02	Do.

Elastic limits not well defined.

LONGITUDINAL COMPRESSION TESTS OF SHRAPNEL CASES.

FIRST CASE.

Threaded section at forward end cut off.
Exterior diameter, 2″.98.
Interior diameter, 2″.65.
Sectional area, minimum, 1.46 square inches.
Gauged length, established forward the band, 5″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
1,460	1,000	0.	0.	Initial load.
14,600	10,000	.0010	.....	
29,200	20,000	.0023	.....	
43,800	30,000	.0036	0.	
51,100	35,000	.0043	.....	
58,400	40,000	.0050	.....	
65,700	45,000	.0058	.....	
73,000	50,000	.0070	.0009	
80,300	55,000	.0090	.....	
87,600	60,000	.0124	.0048	
94,900	65,000	.0176	.....	
102,200	70,000	.0234	.0145	
109,500	75,000	.0315	.....	
116,800	80,000	.0396	.0289	
124,100	85,000	.0486	.....	
131,400	90,000	.0590	.0473	
177,000	121,230	.....	.....	Ultimate strength.

The case buckled near the forward end, near the place of minimum sectional area. Buckling was continued until the case was shortened to 7″.46 over all. Two longitudinal cracks were opened.

Length of circumference over the maximum diameter of the buckled part, 10″.86.

Circumferential extension, 1″.50 = 16 per cent.

SECOND CASE.

Threaded section at forward end cut off.
Exterior diameter, 2″.98.
Interior diameter, 2″.65.
Sectional area, 1.50 square inches.
Gauged length, established forward the band, 5″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
1,500	1,000	0.	0.	Initial load.
15,000	10,000	.0012	.....	
30,000	20,000	.0024	.....	
45,000	30,000	.0037	0.	
60,000	40,000	.0050	.....	
67,500	45,000	.0060	.....	
75,000	50,000	.0077	.0013	
82,500	55,000	.0103	.....	
90,000	60,000	.0142	.0064	
97,500	65,000	.0198	.....	
105,000	70,000	.0249	.0157	
112,500	75,000	.0321	.....	
120,000	80,000	.0402	.0290	
127,500	85,000	.0487	.....	
135,000	90,000	.0588	.0464	
183,000	122,000	.....	.....	Ultimate strength.

Buckled near the forward end of the case. Case shortened to 7″.37 over all. Opened three longitudinal cracks.

Length of circumference over maximum diameter of buckled part, 11″.13.

Circumferential extension, 1″.77 = 18.9 per cent.

THIRD CASE.

Threaded section at forward end cut off
Exterior diameter, 2″.98.
Interior diameter, 2″.63.
Sectional area, 1.542 square inches.
Gauged length, established forward the band, 5″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
1,542	1,000	0.	0.	Initial load
15,420	10,000	.0010	.....	
30,840	20,000	.0024	.....	
46,260	30,000	.0036	0.	
61,680	40,000	.0051	.....	
69,390	45,000	.0060	.....	
77,100	50,000	.0074	.0009	
84,810	55,000	.0096	.....	
92,520	60,000	.0133	.0043	
100,230	65,000	.0184	.....	
107,940	70,000	.0254	.0158	
115,650	75,000	.0327	.....	
123,360	80,000	.0418	.0308	
131,070	85,000	.0522	.....	
138,780	90,000	.0642	.0514	
178,500	115,760	.....	.....	Ultimate strength.

Buckled near the forward end of the case. Case shortened to 7″.46 over all. Opened one longitudinal crack.

Length of circumference over maximum diameter of buckled part, 10″.91.

Circumferential extension, 1″.55 = 16.6 per cent.

FOURTH CASE.

Threaded section at forward end cut off.
Exterior diameter, 2″.98.
Interior diameter, 2″.65.
Sectional area, 1.50 square inches.
Gauged length, established forward the band, 5″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
1,500	1,000	0.	0.	Initial load.
15,000	10,000	.0009	.....	
30,000	20,000	.0020	.....	
45,000	30,000	.0033	0.	
60,000	40,000	.0048	.....	
67,500	45,000	.0063	.....	
75,000	50,000	.0085	.0022	
82,500	55,000	.0121	.....	
90,000	60,000	.0174	.0094	
97,500	65,000	.0227	.....	
105,000	70,000	.0307	.0211	
112,500	75,000	.0385	.....	
120,000	80,000	.0472	.0362	
127,500	85,000	.0578	.....	
135,000	90,000	.0695	.0570	
176,800	117,870	.....	.....	Ultimate strength.

The case buckled near the forward end, near the place of minimum sectional area. Buckling was continued until the case was shortened to 7″.39 over all. Two small, longitudinal cracks were opened.

Length of circumference over maximum diameter of the buckled part, 11″.20.

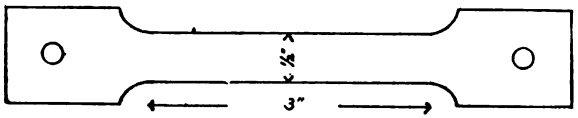
Circumferential extension, 1″.84 = 19.7 per cent.

3-INCH SHRAPNEL CASE.

CHEMICAL ANALYSIS.

Combined carbon	.560
Manganese	.655
Silicon	.141
Sulphur	.050
Phosphorus	.020

TENSILE TESTS OF SPECIMENS FROM 3-INCH SHRAPNEL CASES RECEIVED FROM FRANKFORD ARSENAL, PHILADELPHIA, PA.

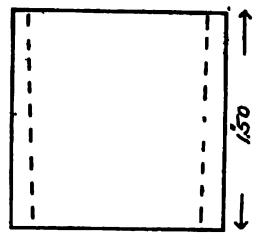


Marks.	Dimensions.		Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation in 3".	Contraction of area.	Elongation of inch sections.			Appearance of fracture.
	Width.	Thickness.									
	Inch.	*Inch.*	*Sq. in.*	*Pounds.*	*Pounds.*	*Per ct.*	*Per ct.*	"	"	"	
A	.500	.15	.075	88,000	117,330	5.7	25.3	.01,	.02,	.14*	Silky; trace of granulation.
A_1	.500	.153	.077	80,520	119,480	5.3	31.2	.01,	.03,	.12*	Do.
B	.500	.141	.071	90,140	115,490	6.7	35.2	.01,	.03,	.16*	Silky.
B_1	.500	.142	.071	78,870	114,080	6.7	25.4	.02,	.10*,	.08*	Do.
C	.500	.153	.077	84,420	111,690	7.3	26.0	.02,	.05,	.15*	Silky; trace of granulation.
C_1	.500	.153	.077	85,710	112,990	5.7	27.3	.02,	.02,	.13*	Do.
D	.499	.153	.076	81,580	111,840	6.7	25.0	.03,	.11*,	.08*	Do.
D_1	.499	.153	.076	75,000	113,160	6.7	34.2	.01,	.03,	.16*	Silky.
E	.499	.152	.076	85,530	114,470	6.7	26.3	.02,	.03,	.15*	Silky; trace of granulation.
E_1	.500	.154	.077	80,520	111,690	6.3	26.0	.01,	.04,	.14*	Do.
F	.500	.149	.075	88,000	121,330	5.0	24.0	.01,	.03,	.11*	Do.
F_1	.500	.150	.075	85,330	124,000	5.0	30.7	.01,	.02,	.12*	Do.

REMARKS.—The elastic limits were vague and difficult of recognition. No sharply defined line existed where permanent sets began. There was a progressive development of sets, gradually increasing as the tensile strength was approached.

ONE-POUNDER DRAWN STEEL SHELLS FROM FRANKFORD ARSENAL, PHILADELPHIA, PA.

MANDREL TESTS.



Exterior diameter, 1″.4430.

Applied loads on mandrel.	Exterior diameter.	Diametrical extension.	Remarks.
Pounds.	*Inches.*	*Inch.*	
0	1.4430	0.	
4,000	1.4445	.0015	
0	1.4430	0.	
5,800	1.4455	.0025	
0	1.4430	0.	
7,500	1.4465	.0035	Elastic limit = 68,000 pounds per square inch.
0	1.4432	.0002	
9,500	1.4475	.0045	
0	1.4444	.0014	
9,000	1.4487	.0057	
0	1.4455	.0025	
.....	1.4782	.0352	Shell ruptured.
.....	.....	.....	Elongation = 2.4 per cent.

Exterior diameter, 1″.4430; length, 1″.50.

Applied loads on mandrel.	Exterior diameter.	Diametrical extension.	Remarks.
Pounds.	*Inches.*	*Inch.*	
0	1.4430	0.	
6,500	1.4464	.0034	Elastic limit = 60,000 pounds per square inch.
0	1.4435	.0005	
6,700	1.4485	.0055	
0	1.4448	.0018	
.....	1.4750	.0320	Shell ruptured with granular fracture.
.....	.....	.....	Elongation = 2.2 per cent.

Exterior diameter, 1″.4419; length, 1″.50.

Applied loads on mandrel.	Exterior diameter.	Diametrical extension.	Remarks.
Pounds.	*Inches.*	*Inch.*	
0	1.4419	0.	
6,500	1.4449	.0030	Elastic limit = 60,000 pounds per square inch.
0	1.4420	.0001	
5,600	1.4461	.0042	
0	1.4434	.0015	
5,300	1.4478	.0059	
0	1.4448	.0029	
.....	1.4824	.0405	Shell ruptured.
.....	.....	.....	Elongation = 2.8 per cent.

TENSILE TESTS.

Dimensions.		Sectional area.	Tensile strength per square inch.	Elongation in 1 inch.	Contraction of area.	Fractured.	Appearance of fracture.
Width.	Thickness.						
Inch.	*Inch.*	*Sq. in.*	*Pounds.*	*Per cent.*	*Per cent.*		
.300	.130	.039	70,500	.....	.....	Across eye.....	Silky.
.300	.080	.024	86,700	.....	41.7	In the stem.....	Do.
.300	.080	.024	82,900	11.0	41.7	.....do.....	Do.
.300	.080	.024	82,500	11.0	41.7	.....do.....	Do.

Rapid elongation occurred just prior to reaching the tensile strength.

LONGITUDINAL COMPRESSION TESTS.

Interior of shell bored out to cylindrical form; exterior surface in primitive condition.

Length of walls of shell, 2.″25.

Diameters.		Sectional area.	Elastic limit per square inch.	Compressive strength per square inch.	Manner of failure.
Exterior.	Interior.				
Inches.	*Inches.*	*Sq. in.*	*Pounds.*	*Pounds.*	
1.443	1.178	.545	64,600	74,900	Walls buckled at base end of specimen.
1.442	1.174	.551	60,800	73,700	Do.
1.443	1.174	.553	63,700	77,800	Do.
Complete shell with truncated end.....				[a] 44,800	Walls buckled at base of ogival.

[a] Total compressive strength.

TENSILE TESTS OF 3.2-INCH CAST IRON SHELLS WITH STEEL GAS SHIELDS CAST IN POSITION IN BODY UNDER THE GROOVE FOR THE BAND.

The shells were in part turned down in exterior diameter at the place of the steel shield, and part of the number were bored out in the interior until in each case such a sectional area of metal, in annular form, remained as permitted of testing by tension, taken longitudinally with reference to the axis of the shell.

Marks.	Dimensions of specimen.		Sectional area.	Tensile strength.		Appearance of fracture.
	Interior.	Exterior.		Total.	Per square inch.	
	Inches.	*Inches.*	*Sq. in.*	*Pounds*	*Pounds*	
T	.88	1.70	1.66	18,820	11,340	Fine granular, gray. Did not fracture at junction of cast iron and steel.
	2.62	2.98	1.58	25,700	16,270	Fine granular, gray. Fractured in close vicinity of junction of cast iron and steel, but no bright spots visible.
	2.46	2.89	1.81	24,800	13,700	Fine granular, gray. Two bright, smooth spots ″.22×″.20 and ″.22×″.07, respectively.
	2.46	2.89	1.81	21,500	11,880	Fine granular, gray. Two bright, smooth spots ″.23×″.12 and ″.23×″.15, respectively.
T_1	.89	1.61	1.41	15,500	10,990	Fine, granular, gray. Did not fracture at junction of cast iron and steel.
T_2	.89	1.61	1.41	13,700	9,720	Do.
T_3	.89	1.61	1.41	14,900	10,570	Do.
T_4	.89	1.61	1.41	Not ascertained.		Do.

The ninth shell was turned off at the junction of the shield and cast iron. The shield in this specimen was disposed at an inclination to a plane normal to the axis of the shell, the obliquity being ″.3 on an exterior diameter of 1″.9; i. e., the distance from the base of the shell to the shield was ″.3 greater on one longitudinal element than on the opposite element of the cylinder 1″.9 diameter. On the rear side of the shield the cast iron showed a line of spongy metal ″.4 long, and a small, spongy spot ″.05 diameter.

The tenth specimen was one-half a shell, upon which no test was made.

STEEL CASTINGS FOR GUN AND CARRIAGE WORK.

STEEL CASTINGS FOR GUN AND CARRIAGE WORK.

FROM THE ARSENAL TROPENAS STEEL CASTING PLANT.

Heat number.	Chemical composition.					Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fractures.
	Carbon.	Manganese.	Silicon.	Sulphur.	Phosphorus.	*Pounds.*	*Pounds.*	*Per cent.*	*Per cent.*	" "	
279	.31	.75	.....	.034	.040	(a)					
280	.32	.77	.352	.040	.042						
281	.32	.77	.450	.035	.042	56,000	73,000	26.0	37.1	.30*, .22	Silky.
						45,000	101,500	14.0	16.9	.11, .17*	Granular.
						44,000	102,500	15.0	20.5	.14*, .16*	Granular; silky spot.
282	.31	.79	.428	.035	.041	43,000	82,500	21.0	27.4	.19*, .23*	Silky.
						40,500	80,000	19.5	24.0	.22*, .17	Silky, 80 per cent; granular, 20 per cent.
283	.32	.75	.462	.038	.042	43,000	87,500	18.5	25.0	.18, .19	Silky, 60 per cent; granular, 40 per cent.
284	.32	.78	.404	.035	.041	41,000	76,500	24.0	30.7	.22, .26*	Silky.
						40,500	79,500	20.0	23.9	.19, .21*	Silky; in part granular.
						40,300	79,590	17.0	22.4	.17*, .17	Dull silky.
						42,000	77,000	24.0	37.1	.26*, .22	Silky.
285	.30	.79	.371	.031	.041	(a)					
286	.30	.78	.253	.039	.040	34,000	67,000	29.5	27.4	.32*, .27	Do.
						42,500	77,500	25.5	34.0	.21, .30*	Do.
						35,000	73,500	22.0	24.0	.19, .25*	Silky; trace of granulation.
287	.30	.81	.237	.043	.040	39,000	73,000	24.0	34.0	.18, .30*	Silky.
						36,500	69,000	30.5	49.1	.24, .37*	Do.
288	.30	.84	.354	.046	.041	35,500	68,500	31.0	49.1	.38*, .24	Do.
						39,500	77,500	20.0	23.9	.24*, .16	Dull silky.
						35,500	68,500	27.0	40.3	.33*, .21	Silky.
289	.30	.80	.218	.044	.040	34,500	70,000	31.0	43.3	.35*, .27	Do.
290	.31	.80	.291	.039	.038	45,000	102,500	16.0	16.9	.17*, .15	Granular.
						37,500	68,000	23.0	20.5	.26*, .20	Silky.
291	.31	.79	.343	.036	.038	34,000	69,000	24.0	27.4	.21, .27*	Do.
						42,000	87,500	19.5	23.9	.17, .22*	Granular, 60 per cent; silky, 40 per cent.
292	.30	.79	.356	.046	.039	35,500	72,000	27.0	37.1	.31*, .23	Silky.
293	.32	.77	.413	.036	.040						
294	.36	.79	.521	.047	.041	41,500	78,000	22.5	23.9	.25*, .20*	Do.
295	.36	.77	.504	.048	.039	33,500	72,000	29.0	46.2	.36*, .22	Do.
						51,500	84,000	11.5	20.5	.09, .14*	Amorphous; irregular.
						45,500	74,000	26.0	30.7	.28*, .24	Silky.
296	.32	.77	.432	.046	.039	34,500	72,500	32.5	49.1	.41*, .24	Do.
297	.32	.77	.282	.047	.040	37,500	76,000	12.5	16.9	.10, .15*	Granular.
						37,500	74,000	11.5	13.2	.10, .13*	Dull silky, 60 per cent; granular, 40 per cent.
						34,500	67,000	30.5	49.1	.40*, .21	Silky.

a Metal subsequently forged, not tested in the casting.

STEEL CASTINGS FOR GUN AND CARRIAGE WORK—Continued.

FROM THE ARSENAL TROPENAS STEEL CASTING PLANT—Continued.

Heat number.	Chemical composition.					Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fractures.
	Carbon.	Manganese.	Silicon.	Sulphur.	Phosphorus.						
						Pounds.	*Pounds.*	*Per cent.*	*Per cent.*	" "	
298	.31	.76	.267	.047	.040						
299	.32	.77	.376	.045	.039						
300	.32	.77	.421	.050	.040	48,500	84,500	18.5	24.0	.15, .22*	Silky.
						42,000	83,500	18.0	20.5	.21*, .15	Silky, 60 per cent; granular, 40 per cent.
						40,500	82,000	19.0	20.5	.20*, .18	Silky, 40 per cent; granular, 60 per cent.
301	.32	.81	.385	.050	.041						
302	.27	.78	.291	.038	.042						
303	.30	.77	.345	.043	.040	(a)					
304	.30	.76	.323	.038	.040	32,500	73,000	29.5	40.3	.37*, .22	Silky.
						40,500	86,500	17.0	16.9	.16, .18*	Granular.
						42,500	85,500	19.5	24.0	.22*, .17	Do.
305	.29	.79	.273	.047	.042						
306	.30	.77	.413	.046	.042						
307	.30	.76	.450	.052	.041	44,000	83,000	16.0	16.9	.14, .18*	Silky, 20 per cent; granular, 80 per cent.
						38,000	82,000	13.5	16.9	.15*, .12	Granular; silky spot.
						53,000	77,500	7.5	9.5	.09, .06	Dull silky; trace of granulation.
						39,000	78,500	10.0	9.5	.09, .11*	Granular; silky spot.
						39,500	79,000	16.0	20.5	.19*, .13	Granular, 50 per cent; silky, 50 per cent.
						39,500	80,500	18.0	24.0	.23*, .13	Granular, 40 per cent; silky, 60 per cent.
308	.29	.74	.376	.046	.042						
309	.29	.76	.408	.045	.038	29,500	65,500	27.0	37.1	.32*, .22	Silky.
310	.30	.78	.334	.039	.038	30,000	68,500	27.0	37.1	.25, .29*	Do.
						38,000	70,000	12.5	16.9	.09, .16*	Do.
						38,000	73,500	23.5	27.4	.18, .29*	Silky; irregular.
311	.30	.80	.258	.032	.040	41,500	75,000	23.5	30.7	.18, .29*	Silky.
						40,500	81,000	24.0	30.7	.21, .27*	Silky; trace of granulation.
312	.28	.75	.243	.039	.038	34,500	74,000	26.5	43.3	.21, .32*	Silky.
						35,000	71,000	19.0	27.4	.22*, .16	Do.
313	.30	.79	.335	.038	.039	30,000	64,000	29.0	40.3	.34*, .24	Do.
314	.31	.79	.282	.046	.040	35,500	69,500	24.5	30.7	.26*, .23	Do.
315	.31	.78	.286	.035	.040	33,000	70,000	29.5	37.1	.29, .30*	Do.
						44,500	74,500	12.5	9.5	.16*, .09	Dull silky.
						37,000	67,500	14.0	24.0	.10, .18*	Dull silky; irregular.
						44,000	69,500	14.0	20.5	.10, .18*	Silky; trace of granulation.
316	.38	.76	.342	.038	.045	(a)					
317	.40	.76	.394	.038	.045	(a)					

318	.36	.78	.353	.030	.045	39,500	82,500	19.0	20.5	.16, .22*	Silky, 75 per cent; granular, 25 per cent.
						30,000	64,500	20.5	27.4	.23*, .18	Dull silky; trace of granulation.
319	.32	.81	.338	.036	.045	33,500	72,000	27.5	40.3	.27, .28*	Silky.
						48,500	83,500	9.5	16.9	.10*, .09	Dull silky.
						47,000	78,500	13.0	16.9	.10, .16*	Do.
						46,500	73,500	11.0	16.9	.12*, .10	Dull silky; irregular.
320	.42	.74	.336	.037	.043	(a)					
321	.41	.74	.355	.038	.044	(a)					
322	.42	.74	.344	.036	.043	36,000	75,000	22.5	27.4	.20, .25*	Silky; irregular.
						42,500	82,000	17.0	20.5	.19*, .15	Silky, 40 per cent; granular, 60 per cent.
323	.44	.76	.357	.040	.042	(a)					
324	.46	.76	.386	.037	.041	41,500	79,000	15.0	16.9	.16*, .14	Silky; irregular.
						47,500	80,000	8.5	9.5	.10*, .08	Dull silky.
						55,000	85,000	4.5	1.8	.05*, .04	Dull silky, 25 per cent; granular, 75 per cent.
						53,000	85,000	12.0	20.5	.13*, .11	Silky.
325	.36	.76	.323	.036	.042	38,500	81,500	20.0	24.0	.18, .22*	Silky; trace of granulation.
						32,500	72,500	26.0	40.3	.34*, .18	Silky.
326	.35	.76	.305	.029	.050	32,500	69,000	26.0	37.1	.35*, .17	Silky; oblique.
327	.35	.77	.253	.032	.036	39,500	80,000	20.0	24.0	.20*, .20	Silky, 20 per cent; granular, 80 per cent.
328	.36	.76	.340	.038	.037	35,500	69,500	26.5	37.1	.20, .33*	Silky.
329	.36	.76	.360	.040	.040	39,500	72,500	24.0	30.7	.21, .27*	Silky; trace of granulation.
						43,000	80,500	12.0	13.2	.11, .13*	Granular, 85 per cent; silky, 15 per cent.
						36,500	74,500	25.0	34.0	.28*, .22	Silky; irregular.
330	.37	.78	.384	.035	.035	47,000	125,500	8.5	9.5	.08, .09*	Granular.
						44,500	78,500	20.5	27.4	.23*, .18	Silky.
						57,000	128,000	6.0	9.5	.08*, .04	Granular.
331	.35	.76	.316	.042	.040	34,000	69,000	24.0	34.0	.19, .29*	Silky.
332	.36	.78	.321	.039	.040	45,500	80,500	21.0	24.0	.22*, .20*	Silky; trace of granulation.
333	.36	.76	.389	.045	.038	56,000	109,000	15.0	16.9	.13, .17*	Granular.
						59,000	59,000	1.0	1.8	.02*, .00	Granular; spongy.
334	.35	.79	.329	.047	.038	32,500	71,500	30.0	46.2	.25, .35*	Silky.
						35,500	70,000	29.5	43.3	.22, .37*	Do.
						42,000	73,500	28.0	40.3	.35*, .21	Do.
335	.35	.81	.319	.040	.041	38,500	73,000	25.0	27.4	.20, .30*	Do.
336	.34	.80	.319	.047	.040	38,000	70,500	16.5	24.0	.14, .19*	Dull silky.
337	.34	.79	.315	.052	.040	34,000	73,500	24.0	30.7	.21, .27*	Silky.
						39,000	70,500	9.5	13.2	.07, .12*	Dull silky; trace of granulation.
						44,500	78,500	11.5	13.2	.13*, .10	Dull silky.
						43,500	82,000	9.5	9.6	.08, .11*	Dull amorphous; oblique.
						38,000	77,000	22.5	27.4	.20, .25*	Silky, 60 per cent; granular, 40 per cent.
338A	.53	.74	.282	.051	.041	42,000	82,000	15.0	16.9	.14, .16*	Granular; cracks in stem.
						40,500	84,500	19.5	24.0	.17, .22*	Granular; silky spot.
						45,500	85,500	15.5	20.5	.16*, .15	Do.
338B	.35	.76	.282	.051	.041	39,000	68,500	19.0	24.0	.16, .22*	Dull silky.
339	.34	.79	.291	.048	.040	34,000	72,000	26.5	40.3	.24, .29*	Silky.
						44,000	75,500	23.0	30.7	.21, .25*	Silky; oblique.
340A	.56	.79	.376	.044	.040	(a)					
340B	.36	.78	.376	.044	.040	37,000	77,500	14.5	20.5	.18*, .11	Dull gray; amorphous.
						33,500	66,500	14.0	20.5	.11, .17*	Dull silky.
						34,500	67,000	13.0	16.9	.10, .16*	Silky; irregular.
						33,000	73,000	27.5	40.3	.32*, .23	Silky.

[a] Metal subsequently forged, not tested in the casting.

STEEL CASTINGS FOR GUN AND CARRIAGE WORK—Continued.

FROM THE ARSENAL TROPENAS STEEL CASTING PLANT—Continued.

Heat number.	Chemical composition.					Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fractures.
	Carbon.	Manganese.	Silicon.	Sulphur.	Phosphorus.						
						Pounds.	*Pounds.*	*Per cent.*	*Per cent.*	" "	
341	.35	.79	.300	.044	.042	36,000	71,500	10.0	16.9	.12*, .08	Dull gray; amorphous.
						37,000	71,000	15.0	20.5	.16*, .14	Silky.
						37,000	72,000	13.0	13.2	.14*, .12	Silky, 30 per cent; granular, 70 per cent.
						37,000	71,500	22.5	30.7	.21*, .24*	Silky.
342	.59	.84				(a)					
343	.61	.84	.352	.058	.048	(a)					
344	.63	.85	.517	.047	.045						
345	.63	.84	.490	.047	.045	(a)					
346	.61	.85	.400	.040	.043						
347	.60	.84	.376	.054	.041	(a)					
348A	.37	.83	.321	.059	.043	43,500	77,000	17.0	20.5	.15, .19*	Dull silky; irregular.
348B	.59	.81									
349A	.36	.83	.324	.052	.045	33,500	68,000	25.5	30.7	.29*, .22	Silky.
						42,500	69,500	12.0	16.9	.14*, .10	Silky; irregular.
						47,500	76,500	20.0	20.5	.23*, .17	Do.
349B	.36	.83	.324	.052	.045	(b)					
350	.37	.77	.257	.054	.045	33,500	72,000	27.5	43.3	.23, .32*	Silky.
						36,000	72,000	29.0	43.3	.29*, .29*	Fine silky.
						32,000	74,500	27.0	40.3	.21, .33*	Silky; oblique.
351	.37	.78	.262	.060	.045	36,500	67,500	10.0	13.2	.12*, .08	Dull silky; irregular.
						39,000	72,000	28.5	49.1	.27*, .30*	Fine silky.
352	.37	.78	.344	.060	.045	44,500	92,000	20.0	24.0	.20*, .20	Granular; silky spot.
353	.40	.81	.395	.060	.045	34,000	71,500	28.0	46.2	.32*, .24	Silky.
354	.34	.65	.300	.054	.048	43,500	94,000	17.5	20.5	.18*, .17*	Granular; silky spot.
355	.58	.65	.241	.068	.049	(a)					
356	.58	.67	.230	.064	.048						
357	.35	.67	.218	.062	.048	37,000	67,500	32.0	43.3	.29, .35*	Silky.
						34,000	73,500	11.0	13.2	.10, .12*	Granular; blowhole.
						39,000	77,000	25.0	34.0	.21, .29*	Silky.
358	.34	.66	.218	.062	.049	37,500	69,000	30.0	46.2	.24, .36*	Do.
359	.42	.64	.212	.057	.045	36,000	77,000	23.5	34.0	.20, .27*	Silky; oblique.
360	.37	.63	.216	.057	.045	33,000	69,000	26.5	34.0	.28*, .25	Silky; irregular.
361	.37	.64	.225	.060	.045	35,500	72,000	27.5	40.3	.24, .31*	Silky.
362	.37	.64	.212	.060	.045	33,000	68,500	26.5	27.4	.26*, .27	Do.
363	.38	.62	.223	.053	.045	33,500	74,500	16.5	16.9	.18*, .15	Granular, 60 per cent; silky, 40 per cent.
						38,500	68,000	23.0	24.0	.20, .26*	Silky; oblique.

364	.40	.64	.253	.054	.046	37,500	77,500	22.0	34.0	.19, .25*	Granular, 50 per cent; silky, 50 per cent.
365	.34	.67	.201	.058	.048	32,500	71,500	23.0	34.0	.20, .26*	Silky.
366	.34	.68	.272	.060	.048	34,000	76,500	22.0	24.0	.25*, .19	Silky; oblique.
						35,000	76,000	26.0	43.3	.21, .31*	Silky.
367	.33	.67	.253	.070	.045	33,000	68,500	19.0	24.0	.16, .22*	Dull silky.
368	.40	.67	.216	.063	.048	32,500	70,000	27.0	43.3	.23, .31*	Silky.
						42,000	72,500	28.0	43.3	.35*, .23	Do.
369	.32	.65	.188	.069	.048	29,000	64,500	28.0	40.3	.35*, .21	Do.
370	.32	.65	.188	.070	.048	31,500	66,500	26.0	34.0	.30*, .22	Silky; irregular.
371	.32	.62	.190	.069	.048	29,500	61,500	18.5	20.5	.13, .24*	Silky; oblique.
						32,500	72,000	28.0	40.3	.30*, .26	Silky.
372	.38	.63	.208	.054	.048	37,000	68,000	23.0	27.4	.21, .25*	Silky; cracks in stem.
373	.34	.63	.280	.060	.045						
374	.34	.63	.255	.070	.045	34,000	72,000	26.0	37.1	.28*, .24	Silky.
375	.34	.66	.188	.043	.045	35,500	74,000	17.5	24.0	.14, .21*	Silky; trace of granulation.
						44,000	101,000	10.5	9.6	.11*, .10	Granular.
						43,000	98,500	11.5	13.2	.12*, .11	Do.
376	.58	.66	.225	.050	.045	41,500	97,000	10.0	13.2	.09, .11*	Do.
377	.59	.65	.235	.040	.048	49,500	97,500	5.0	5.7	.05, .05*	Do.
						47,500	102,500	7.0	5.7	.05, .09*	Do.
						47,000	98,500	8.5	9.6	.08, .09*	Do.
						44,000	95,500	7.5	5.7	.06, .09*	Do.
378	.33	.66	.225	.054	.046	37,500	72,000	28.0	40.3	.36*, .20	Silky.
379	.33	.65	.215	.059	.045	(a)					
380	.61	.64	.282	.054	.040	(a)					
381	.40	.63	.225	.051	.040	41,000	82,000	22.5	27.4	.18, .27*	Granular, 60 per cent; silky, 40 per cent.
382	.42	.63	.258	.060	.040	41,500	78,500	18.5	24.0	.21*, .16	Dull silky and granular.
						43,500	77,500	13.5	13.2	.11, .16*	Granular; silky spot.
						44,000	80,500	21.5	30.7	.25*, .18	Granular, 60 per cent; silky, 40 per cent.
383	.61	.64	.220	.058	.040	(a)					
384	.42	.63	.282	.047	.041	(a)					
385	.57	.66	.240	.040	.047	41,500	85,500	19.5	24.0	.17, .22*	Do.
386	.40	.66	.240	.040	.042	41,000	73,000	30.0	46.2	.29, .31*	Silky.
						36,500	76,000	26.0	37.1	.22, .30*	Do.
387	.31	.65	.221	.035	.043						
388	.31	.64	.140	.041	.043						
389	.40	.64	.225	.044	.045	33,000	73,500	22.5	30.7	.20, .25*	Granular.
						38,500	78,000	15.0	16.9	.16*, .14	Granular; silky spot.
						41,000	82,000	17.0	20.5	.14, .20*	Do.
390	.33	.65	.235	.048	.045	34,500	73,000	28.0	43.3	.32*, .24	Silky.
391	.41	.64	.249	.048	.044	38,000	73,500	21.5	27.4	.26*, .17	Dull silky; oblique.
392	.60	.64	.250	.045	.045	(a)					
393	.62	.65	.210	.048	.046						
394	.33	.64	.210	.043	.045	(a)					
395	.40	.63	.225	.028	.044	34,000	75,000	16.0	16.9	.18*, .14	Granular, 60 per cent; silky, 40 per cent.
						37,000	73,000	15.0	27.4	.12, .18*	Silky; trace of granulation.
396	.60	.62	.246	.030	.045	46,000	97,000	9.0	9.6	.09*, .09	Granular; silky spot.
						40,500	94,500	9.0	9.6	.08, .10*	Do.
						42,000	93,500	9.5	13.2	.08, .11*	Do.
397	.34	.62	.244	.038	.045	35,000	69,000	23.0	34.0	.20, .26*	Silky.

[a] Metal subsequently forged, not tested in the casting.

STEEL CASTINGS FOR GUN AND CARRIAGE WORK—Continued.

FROM THE ARSENAL TROPENAS STEEL CASTING PLANT—Continued.

Heat number.	Chemical composition.					Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fractures.
	Carbon.	Manganese.	Silicon.	Sulphur.	Phosphorus.						
						Pounds.	*Pounds.*	*Per cent.*	*Per cent.*	" "	
398	.40	.62	.240	.037	.045	(a)					
399	.59	.76	.300	.028	.038	42,500	106,500	6.5	5.7	.05, .08*	Granular.
						56,000	119,500	10.0	13.2	.11*, .09	Do.
						47,000	109,000	7.5	9.6	.07, .08*	Do.
						44,500	110,500	10.5	13.2	.09, .12*	Do.
						50,000	114,000	10.5	13.2	.10, .11*	Granular; silky center.
						48,500	94,500	10.0	9.6	.10, .10*	Granular; silky spot.
						48,000	102,500	16.0	20.5	.12, .20*	Do.
400	.43	.76	.230	.028	.040	40,500	82,500	19.5	27.4	.23*, .16	Silky; trace of granulation.
401	.43	.76	.245	.027	.040	37,000	73,000	26.0	34.0	.25, .27*	Silky.
402	.60	.68	.225	.032	.040	(a)					
403	.54	.67	.225	.036	.042	27,000	63,000	30.5	46.2	.25, .36*	Do.
						38,000	72,000	26.0	34.0	.32*, .20	Do.
404	.58	.66	.230	.035	.040	(a)					
405	.35	.65	.188	.037	.042	29,500	60,500	30.5	51.9	.40*, .21	Do.
406	.49	.67	.188	.035	.042	33,500	69,500	26.5	37.1	.23, .30*	Silky; oblique.
						42,000	78,000	25.0	37.1	.19, .31*	Silky.
407	.59	.66	.230	.034	.040	(a)					
408	.41	.65	.225	.036	.042	33,000	69,500	25.5	34.0	.32*, .19	Silky; oblique.
						42,000	83,000	20.0	24.0	.21*, .19	Granular, 60 per cent; silky, 40 per cent.
409	.34	.65	.235	.034	.042	31,500	58,000	32.5	51.9	.23, .42*	Silky.
						33,500	69,500	26.0	30.7	.19, .33*	Do.
410	.34	.65	.220	.040	.040	(a)					
411	.53	.67	.188	.030	.040	38,500	101,000	15.5	20.5	.16*, .15*	Granular.
	.57	.67	.188	.030	.040	41,000	104,000	9.5	13.2	.10*, .09	Granular; silky spot.
						40,000	104,500	11.5	13.2	.10, .13*	Granular.
412	.41	.67	.200	.032	.042	37,500	79,000	17.0	20.4	.16, .18*	Granular; silky spot.
						38,500	82,000	20.0	27.4	.16, .24*	Granular, 40 per cent; silky, 60 per cent.
413	.34	.67	.188	.030	.042	33,500	70,500	18.0	20.4	.19*, .17	Dull silky; irregular.
						37,500	77,000	24.0	34.0	.19, .29*	Silky; trace of granulation.
						28,500	74,500	22.5	34.0	.26*, .19	Silky.
414	.58	.69	.216	.035	.042						
	.40	1.00	.216	.035	.042						
	.40	.90	.216	.035	.042						
415	.40	.67	.239	.032	.042	42,500	86,500	18.5	27.4	.14, .23*	Granular, 50 per cent; silky, 50 per cent.
						43,500	84,000	17.5	20.4	.20*, .15	Granular, 60 per cent; silky, 40 per cent.

						45,000	82,500	10.0	13.2	.12*, .08	Granular, 50 per cent; dull gray, 50 per cent.
						35,500	71,000	10.5	13.2	.12*, .09	Granular; silky spot.
						42,000	78,000	22.5	27.4	.19, .26*	Silky.
						52,000	99,500	16.5	24.0	.20*, .13	Granular; silky spot.
						32,000	72,000	25.0	34.0	.23, .27*	Silky.
						39,000	78,500	9.5	9.6	.10*, .09	Granular; cracks in stem.
416	.38	.67	.226	.035	.042	40,500	77,500	25.0	34.0	.28*, .22	Silky.
	.35	1.00	.226	.035	.042	27,500	71,500	23.0	30.7	.24*, .22	Granular, 55 per cent; silky, 45 per cent.
						37,500	80,000	18.0	20.5	.21*, .15	Dull gray; silky.
417	.56	.68	.319	.035	.042	(a)					
418	.43	.71	.206	.032	.045	43,000	83,500	6.0	5.7	.06*, .06	Granular.
						45,000	94,000	20.0	24.0	.20*, .20*	Granular, 60 per cent; silky, 40 per cent.
						46,000	96,500	17.5	20.5	.20*, .15	Granular; silky spot.
						47,500	94,000	20.5	30.7	.16, .25*	Granular, 50 per cent; silky, 50 per cent.
						36,000	82,000	20.5	24.0	.21, .40*	Granular, 70 per cent; silky, 30 per cent.
419	.43	.71	.206	.035	.045	35,500	74,000	25.5	34.0	.24, .27*	Silky.
420	.35	.71	.223	.031	.040	48,500	104,000	19.5	34.0	.14, .25*	Silky; trace of granulation.
						57,300	97,500	20.0	30.7	.23*, .17	Do.
						33,000	74,500	17.0	20.5	.15, .19*	Silky.
						41,500	79,500	16.5	20.5	.18*, .15	Granular; silky spot.
421	.58	.71	.254	.030	.035	(a)					
422	.41	.72	.244	.030	.036	49,000	88,000	10.5	13.2	.10, .11*	Do.
						43,500	82,500	14.0	20.5	.17*, .11	Silky.
						41,500	76,000	10.5	9.6	.11*, .10	Dull gray; amorphous.
						51,500	98,000	10.0	13.2	.07, .13*	Fine granular; silky spot.
						33,000	62,000	32.5	49.1	.39*, .26	Silky.
423	.41	.71	.272	.032	.035	48,500	91,500	11.5	13.2	.10, .13*	Granular; silky spot.
						38,000	75,000	13.5	20.5	.15*, .12	Silky; dendritic.
						40,500	79,000	16.0	20.5	.15, .17*	Granular; silky spot.
						48,000	104,500	17.0	24.0	.21*, .13	Do.
424	.37	.71	.254	.030	.035	38,000	76,000	16.0	20.5	.17*, .15	Silky, 60 per cent; granular, 40 per cent.
425	.61	.70	.290	.030	.035	(a)					
426	.37	.98	.300	.030	.035	38,500	80,000	15.0	16.9	.17*, .13	Granular; silky spot.
	.37	.98	.347	.030	.035	40,500	81,500	14.0	16.9	.15*, .13	Granular and silky.
						41,000	82,000	14.5	13.2	.14*, .15	Do.
						38,000	80,500	17.0	20.5	.14, .20*	Do.
						44,500	76,000	13.5	16.9	.12, .15*	Do.
						48,000	75,500	11.0	16.9	.12*, .10	Dull gray; amorphous.
						45,500	78,500	18.0	24.0	.20*, .16	Silky.
						47,000	92,000	9.5	13.2	.09, .10*	Granular; silky spot.
						50,500	97,000	14.0	16.9	.15*, .13	Do.
						53,000	103,000	15.0	24.0	.11, .19*	Granular.
						53,000	103,000	17.0	30.7	.23*, .11	Fine granular and silky.
427	.42	.71	.280	.028	.037	37,000	84,000	20.5	24.0	.20, .21*	Granular; silky spot.
428	.42	.72	.244	.030	.035	38,500	80,500	13.0	13.2	.12, .14*	Granular, 70 per cent; silky, 30 per cent.
						43,880	78,060	19.5	18.9	.12, .17*	Dull silky.
						33,000	79,000	22.0	30.7	.27*, .17	Granular, 55 per cent; silky, 45 per cent.
						39,000	77,000	15.0	16.9	.13, .17*	Granular; silky spot.
						44,000	74,500	20.5	27.4	.24*, .17	Granular, 60 per cent; silky, 40 per cent.
429	.58	.71	.190	.040	.035	(a)					

[a] Metal subsequently forged, not tested in the casting.

STEEL CASTINGS FOR GUN AND CARRIAGE WORK—Continued.

FROM THE ARSENAL TROPENAS STEEL CASTING PLANT—Continued.

Heat number.	Chemical composition.					Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fractures.
	Carbon.	Manganese.	Silicon.	Sulphur.	Phosphorus.						
						Pounds.	*Pounds.*	*Per cent.*	*Per cent.*	" "	
430	.36	1.02	.539	.027	.035	45,500	78,000	8.0	9.6	.07, .09*	Granular, 50 per cent; silky, 50 per cent.
	.41	.73	.188	.027	.037	47,000	80,000	8.5	13.2	.10*, .07	Dull gray; amorphous.
						34,000	82,000	24.0	24.0	.23, .25*	Granular, 70 per cent; silky, 30 per cent.
						55,000	102,000	14.5	24.0	.19*, .10	Granular and silky.
						38,000	77,000	19.5	24.0	.20*, .19	Granular, 55 per cent; silky, 45 per cent.
431	.40	.71	.185	.038	.035	32,500	62,000	28.5	37.1	.33*, .24	Silky.
432	.58	.72	.190	.035	.035	30,000	71,500	21.5	24.0	.24*, .19	Granular; silky spot.
						37,500	77,000	21.0	24.0	.19, .23*	Granular, 60 per cent; silky, 40 per cent.
433	.58	.66	.300	.025	.038	(a)					
434	.41	.65	.253	.025	.038	33,500	75,500	9.5	9.6	.07, .12*	Granular; silky spot.
						40,500	76,500	17.5	20.5	.15, .20*	Granular, 40 per cent; silky, 60 per cent.
435	.40	.66	.258	.028	.036	34,500	74,500	19.0	20.5	.19*, .19*	Granular, 50 per cent; silky, 50 per cent.
436	.61	.67	.249	.028	.037	(a)					
437	.41	.67	.225	.028	.035	38,000	75,500	25.5	37.1	.31*, .20	Silky.

Heat number.	Chemical composition.						Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Carbon.	Manganese.	Silicon.	Sulphur.	Phosphorus.	Nickel.						
							Pounds.	*Pounds.*	*Per cent.*	*Per cent.*	" "	
438	.39	.65	.67	.028	.035	2.95	60,500	118,000	15.0	24.0	.19*, .11	Fine granular and silky.
438A	.40	.70	.268	.027	.037	.....	34,000	72,000	19.5	20.5	.17, .22*	Granular, 50 per cent; silky, 50 per cent.
							39,000	77,000	18.5	24.0	.18, .19*	Granular, 60 per cent; silky, 40 per cent.
439	.36	.66	.210	.029	.037	.....	37,000	72,000	22.0	30.7	.23*, .21	Silky.
440	.40	.62	.160	.028	.030	.....	(a)					
441	.42	.68	.202	.030	.030	.....	36,500	77,000	22.5	27.4	.26*, .19	Silky, 70 per cent; granular, 30 per cent.
442												
443	.41	.67	.202	.030	.032	.....	35,500	70,500	21.0	27.4	.18, .24*	Silky.
							35,500	74,500	21.0	24.0	.24*, .18	Do.
444	.40	.67	.....	.....	.....	2.47	37,500	71,000	22.5	30.7	.16, .29*	Dull silky.
							43,500	72,500	25.0	34.0	.19, .31*	Do.
							70,000	101,500	13.5	20.5	.10, .17*	Dull gray; vesicular.

444A	.40	.65	.250	.030	.030	.....	31,500	64,500	25.5	34.0	.21, .30*	Silky.
							39,000	75,000	13.5	20.5	.16*, .11	Dull silky; irregular.
							33,500	66,500	6.7	9.6	.08*, .05	Silky, 30 per cent; granular, 70 per cent.
							37,500	74,000	15.0	20.5	.12, .18*	Dull silky; granular spot.
445	.36	.66	.212	.030	.030	.....	33,000	53,500	3.5	9.6	.06*, .03	Granular and silky; smooth spot.
							35,500	76,500	15.0	20.5	.13, .17*	Granular; silky spot.
446	.49	.63	.327	.030	.035	.....	48,000	82,000	17.5	16.9	.16, .19*	Do.
							50,000	82,000	15.0	16.9	.15*, .15	Do.
							51,000	98,500	19.0	24.0	.22*, .16	Silky, 20 per cent; granular, 80 per cent.
446B	.37	.64	.....	.030	.035	2.65	51,500	96,500	11.0	13.2	.10, .12*	Granular; silky spot.
							50,500	80,000	4.0	1.8	.02, .06*	Do.
							50,500	97,500	18.0	24.0	.16, .20*	Silky, 40 per cent; fine granular, 60 per cent.
							50,500	98,500	18.0	24.0	.21*, .15	Silky and granular.
446A	.43	.66	.....	.028	.035	2.43	62,000	95,000	10.0	13.2	.11*, .09	Granular; silky spot.
							58,000	98,000	9.5	13.2	.10*, .09	Do.
							57,500	97,500	12.0	9.6	.13*, .11	Do.
							50,500	98,500	18.0	20.5	.14, .22*	Do.
447	.46	.65	.269	.030	.035	.....	34,500	75,000	25.5	30.7	.21, .30*	Silky; trace of granulation.
448	.45	.67	.294	.032	.035	.....						
449	.43	.63	.229	.032	.035	.....						
450	.43	.66	.250	.020	.035	.....	35,500	73,500	22.5	27.4	.22*, .23	Dull silky; oblique.
							36,000	77,500	20.0	27.4	.22*, .18	Granular, 60 per cent; silky, 40 per cent.
451	.41	.67	.250	.031	.038	.....	(a)					
452	.62	.65	.338	.029	.038	.....						
453	.62	.67	.357	.029	.038	.....						
454	.43	.69	.188	.030	.038	.....	34,000	75,500	23.0	30.7	.29*, .17	Silky, 60 per cent; granular, 40 per cent.
455	.43	.69	.179	.030	.040	.....						
456	.45	.69	.107	.030	.040	.....	(a)					
457	.60	.69	.235	.050	.040	.....	(a)					
							36,000	81,500	15.5	20.5	.18*, .13	Granular; silky spot.
458	.40	.69	.226	.042	.040	2.46	40,500	90,000	19.5	20.5	.19*, .20	Silky, 70 per cent; granular, 30 per cent.
459	.44	.71	.255	.036	.040	.....	37,000	90,000	23.0	27.4	.19, .27*	Silky; granular spot.
460	.46	.71	.267	.030	.038	.....						
461	.45	.73	.340	.026	.038	.....	50,500	85,000	25.0	37.1	.23, .27*	Silky.
							42,500	77,000	24.0	30.7	.28*, .20	Dull silky.
462	.44	.71	.235	.042	.040	.....	(a)					
463	.59	.73	.260	.038	.036	.....	(a)					
464	.42	.72	.282	.035	.038	2.52	53,500	90,000	18.5	24.0	.16, .21*	Silky, 40 per cent; granular, 60 per cent.
							55,000	91,500	20.0	24.0	.23*, .17	Silky and granular.
465	.45	.70	.268	.050	.038	.....	34,000	77,000	14.0	13.2	.13, .15*	Granular; silky spot.
466	.45	.70	.282	.050	.038	.....	36,500	79,000	16.5	20.5	.15, .18*	Dull silky and granular.
467	.44	.70	.272	.030	.036	.....	43,000	90,500	14.0	20.5	.13, .15*	Granular; flaky spot.
							40,000	81,000	7.0	5.7	.08*, .06	Granular; silky spot.
							37,500	74,500	12.5	13.2	.14*, .11	Dull silky.
							40,500	70,000	12.5	20.5	.13*, .12	Do.
468	.45	.72	.226	.036	.040	.....	38,500	72,500	13.0	20.5	.11, .15*	Do.
							36,000	76,000	19.5	20.5	.17, .22*	Granular, 70 per cent; silky, 30 per cent.
469	.51	.67	.340	.030	.038	.....	52,500	90,000	20.0	24.0	.23*, .17	Silky.
							54,500	91,000	17.5	20.5	.15, .20*	Silky, 60 per cent; granular, 40 per cent.

a Metal subsequently forged, not tested in the casting.

STEEL CASTINGS FOR GUN AND CARRIAGE WORK—Continued.

FROM THE ARSENAL TROPENAS STEEL CASTING PLANT—Continued.

Heat number.	Chemical composition.						Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Carbon.	Manganese.	Silicon.	Sulphur.	Phosphorus.	Nickel.						
							Pounds.	*Pounds.*	*Per cent.*	*Per cent.*	" "	
470	.42	1.00	.250	.030	.038	.....	48,500	103,500	17.0	34.0	.15, .19*	Silky, 40 per cent; granular, 60 per cent.
							51,000	100,500	18.0	27.4	.13, .23*	Silky and granular.
471	.46	.72	.343	.035	.040	.....	43.000	92,500	15.0	20.5	.15*, .15*	Granular; silky spot.
472	.46	.75	.300	.035	.040	.....						
473	.45	.71	.300	.036	.038	.....	44,000	88,000	13.0	20.5	.12, .14*	Granular, 80 per cent; silky, 20 per cent.
							44,000	77,500	22.0	24.0	.20, .24*	Dull silky.
474	.46	.84	.300	043	.040	.....	38,000	71,000	25.5	34.0	.20, .31*	Silky.
							43,500	85,000	13.0	13.2	.14*, .12	Granular, 50 per cent; silky, 50 per cent.
							50,500	100,500	15.0	16.9	.15, .15*	Granular.
							46,500	94,500	10.5	16.9	.14*, .07	Do.
							49,000	88,500	19.5	27.4	.25*, .14	Dull silky.
							50.000	99,500	18.5	24.0	.17, .20*	Fine granular, 80 per cent; silky, 20 per cent.
475	.46	.88	.250	.040	.040	.....						
476	.44	.86	.332	.040	.040	.....						
477	.44	.84	.220	.042	.040	.....	44,000	88,000	17.5	16.9	.17, .18*	Granular; flaky spot.
							36,500	82,000	16.5	20.5	.18*, .15*	Granular, 80 per cent; silky, 20 per cent.
478	.43	.84	.275	.040	.038	.....	40.500	81,000	25.0	34.0	.19, .31*	Dull silky.
479	.46	.86	.230	.042	.038	.....	32,000	71,500	23.0	27.4	.26*, .20	Dull silky and granular.
							49.500	89,500	19.5	27.4	.13, .26*	Silky.
							53.500	89.500	18.0	24.0	.19*, .17	Do.
480	.45	.88	.246	.042	.040	.....	37,000	82,000	16.5	20.5	.16, .21*	Granular, 80 per cent; silky, 20 per cent.
481	.46	.87	.230	.040	.042	.....						
482	.44	.86	.239	.043	.040	.....	36,000	77,000	25.0	37.1	.20, .30*	Silky; trace of granulation.
483	.46	.87	.216	.040	.040	.....	38,500	78.000	25.5	34.0	.22, .29*	Silky.
484	.43	.81	.315	.036	.040	.....	41,500	78,000	23.5	37.1	21, .26*	Dull silky.
485	.43	.81	253	.040	.040	.....	37,000	73,000	23.5	30.7	.29*, .18	Silky.
							36,000	79,500	18.0	20.5	.15, .21*	Silky, 20 per cent; granular, 80 per cent.
486	.44	.84	.297	.032	.040	.....	(a)					
487	.46	.85	.247	.032	.040	.....						
488	.45	.83	.275	.030	.040	.....						
489	.40	.98	.259	.037	.042	.....						
490	.40	.96	.235	.022	.042	.....	36,500	74,000	19.0	27.4	.11, .27*	Dull silky.
							35,500	81,000	18.0	24.0	.19, .17	Granular.
491	.43	.89	.200	.042	.040	.....						
492	.44	.80	.223	.045	.040	.....	44,000	79,000	23.5	34.0	.27*, .20	Silky.

493	.42	.86	.235	.033	.040	.....	37,000	77,500	21.5	37.1	.30*, .13	Do.
494	.43	.86	.240	.036	.042	.....						
495	.45	.87	.256	.036	.040	.....	48,000	84,000	16.0	20.5	.16*, .16	Granular; in part silky.
496	.39	.83	.282	.030	.040	.....	(a)					
497	.41	.86	.277	.035	040	.....	47,500	79,500	24.0	37.1	.26*, .22	Silky.
							34,500	81,000	22.5	30.7	.23*, .17	Granular; silky center.
498	.40	.86	.300	.035	.038	.....						
499	.44	.87	.282	.034	.038	.....						
500	.45	.86	.235	.036	.040	.....						
501	.44	.80	.200	.030	.040	.....	(a)					
502	.42	.95	.253	.036	.041	.....	56,500	82,500	10.0	9.6	.10, .10*	Granular; silky spot.
							35,500	81,000	19.0	24.0	.17, .21*	Granular, 50 per cent; silky, 50 per cent.
							36,000	74,000	18.5	24.0	.16, .21*	Dull silky and granular.
							36,000	76,000	20.0	27.4	.23*, .17	Silky; trace of granulation.
503	.41	.94	.210	.035	.039	.....						
504	.44	.83	.235	.035	.040	.....						
505	.45	.80	.224	.035	.040	.....	36,000	75,000	26.5	37.1	.30*, .23	Silky.
506	.44	.85	.235	.036	.041	.....						
507	.43	.86	.200	.036	.036	.....						
508	.42	.84	.210	.036	.039	.....						
509	.44	.82	.195	.035	.040	.....	37,000	77,000	20.0	24.0	.23*, .17	Silky; serrated.
510	.41	.95	.282	.035	.042	.....						
511	.41	.93	.319	.035	.042	.....						
512	.44	.87	.366	.032	.041	.....						
513												
514	.43	.87	.....	.035	.....	.....						
515	.40	.82	.....	.033	.....	.....	45,000	86,000	22.0	30.7	.20, .24*	Dull silky; irregular.
							45,000	86,000	11.5	13.2	.11, .12*	Granular, 60 per cent; silky, 40 per cent.
							45,500	84,500	20.0	27.4	.20, .20*	Silky.
516	.45	.92	.206	.038	.046	.....						
517	.44	.86	.253	.036	.042	.....						
518	.42	.95	.235	.036	.040	.....						
519	.41	.94	.238	.038	.040	.....						
520	.44	.83	.239	.038	.042	.....						
521	.45	.80	.227	.038	.040	.....						
522	.44	.85	.230	.036	.040	.....	(a)					
523	.43	.86	.233	.038	.040	.....						
524	.42	.84	.254	.040	.040	.....	33,000	70,000	21.5	24.0	.18, .25*	Dull silky; oblique.
							40.500	76,500	22.5	30.7	.25*, .20	Dull silky.
525	.44	.82	.270	.041	.040	.....						
526	.41	.95	.260	.038	.040	.....						
527	.41	.93	.310	.036	.040	.....						
528	.42	.68	.....	.028	.040	.....						
529	.41	.96	.....	.029	.040	.....						
530	.40	.96	.....	.031	.040	.....						
531	.42	.89	.....	.030	.040	.....	39,000	82,000	22.0	34.0	.19, .25*	Silky; in part granular.
532	.44	.87	.....	.035	.040	.....						
533	.45	.87	.....	.035	.040	.....						

a Metal subsequently forged, not tested in the casting.

STEEL FORGINGS, GUN AND CARRIAGE WORK.

FORGED STEEL.

FROM WATERTOWN ARSENAL SMITH SHOP.

Stems 2″ long, ″.505 diameter.

75-MILLIMETER MOUNTAIN GUN CARRIAGES.

Marks F.	From ingot cast at Watertown Arsenal, number.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
		Pounds.	*Pounds.*	*Per ct.*	*Per ct.*	" "	
983	.....	58,500	85,500	24.5	40.3	.31,.18	Silky.

6-POUNDER GUN MOUNTS.

997	.....	55,500	92,500	25.0	46.2	.14,.36*	Fine, silky.

15-POUNDER R. F. GUN CARRIAGES.

.....	.....	36,500	65,500	32.0	51.9	.40*,.24	Silky.

6-INCH DISAPPEARING CARRIAGES.

731	1880	60,500	91,500	11.5	20.5	.15*,.08	Dull gray, amorphous, irregular.
656-3	1803	58,000	116,000	16.0	27.4	.22*,.10	Fine granular, 50 per cent; silky, 50 per cent.
731-2	1880	62,500	99,500	8.5	9.5	.11*,.06	Granular.
731-3	1880	47,000	77,500	27.5	37.1	.31*,.24	Silky.
757	2040	51,000	88,000	29.0	49.1	.38*,.20	Fine silky.
759	.....	52,500	101,000	22.5	43.3	.16, .29*	Do.
801	.....	59,000	99,500	23.5	49.1	.19, .28*	Do.
841	.....	56,000	100,000	24.5	46.2	.15, .34*	Do.
881	.....	53,500	98,500	22.0	46.2	.12, .32*	Do.
921	3051	52,000	119,500	11.0	13.2	.10, .12*	Granular.
927	3051	42,000	79,500	27.5	49.1	.19, .36*	Silky.
932	2005	62,000	94,000	25.0	46.2	.14, .36*	Do.
956	1466	50,500	93,000	12.5	23.9	.18*,.07	Silky, 40 per cent; granular, 60 per cent.
921	3051	49,500	121,000	15.0	27.4	.20*,.10	Granular.
927	3051	61,000	102,000	18.0	51.9	.29*,.07	Silky.
960	.....	45,000	78,000	28.5	51.9	.22, .35*	Do.
956-2	1466	59,000	99,000	11.5	20.5	.17*,.06	Silky, 50 per cent; granular, 50 per cent.
966	.....	49,500	109,500	13.5	16.9	.11, .16*	Granular; silky spot.
921-3	3051	45,500	116,500	15.0	20.5	.14, .16*	Granular.
966-2	.....	47,000	106,500	18.5	23.9	.20*,.17	Granular, 75 per cent; silky, 25 per cent.
957-2	3051	60,500	86,000	28.5	71.3	.41*,.16	Fine silky.
960-2	.....	47,500	79,000	24.5	54.6	.39*,.10	Silky.
921	3051	48,500	119,000	11.5	16.9	.08, .15*	Granular.
956	1466	53,000	87,500	18.0	27.4	.25*,.11	Fine granular, 60 per cent; silky, 40 per cent.
979	.....	42,500	101,500	19.5	20.5	.18*,.11	Granular.
979-2	.....	43,500	102,500	13.5	16.9	.10, .17*	Do.
979-3	.....	40,500	98,000	18.0	24.0	.13, .23	Granular; silky spot.
989	.....	53,000	97,500	18.5	37.1	.09, .28*	Silky.
984	.....	56,500	118,000	13.0	20.5	.17*,.09	Granular.
994	.....	48,000	103,000	15.0	20.5	.10, .20*	Granular, 60 per cent; silky, 40 per cent.
989	.....	55,500	97,500	23.0	43.3	.31*,.15	Silky.
981	.....	51,000	100,500	21.0	34.0	.15, .27*	Do.
996	.....	44,000	82,500	25.5	43.3	.20, .31*	Silky; light-colored spot.
979-4	.....	58,500	112,500	16.5	37.1	.08, .25*	Silky; trace of granulation.
1000	.....	50,500	82,500	27.5	54 6	.15, .40*	Fine silky.
1007	.....	53,000	82,000	26.0	46.2	.36*,.16	Do.
971	.....	51,000	101,500	23.0	37.1	.29*,.17	Silky.

FORGED STEEL—Continued.

FROM WATERTOWN ARSENAL SMITH SHOP—Continued.

6-INCH DISAPPEARING CARRIAGES—Continued.

Marks F.	From ingot cast at Watertown Arsenal, number.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
		Pounds.	*Pounds.*	*Per ct.*	*Per ct.*	" "	
1009	.....	56,000	89,500	25.0	49.1	.15, .35*	Fine silky.
1076	.....	50,500	87,000	26.5	51.9	.33*, .20	Do.
1143	.....	38,000	76,500	27.5	46.2	.33*, .22	Do.
984	.....	45,500	104,000	13.0	24.0	.09, .17*	Granular; silky center.
984-S-3	.....	47,000	103,500	16.0	24.0	.14, .18*	Granular; silky spot.
1143	2451	62,000	103,000	20.0	46.2	.30*, .10	Fine silky.
996-S-2	1466	54,500	94,000	25.0	51.9	.18, .32*	Do.
994-2	.....	51,500	109,000	14.0	24.0	.09, .19*	Granular; silky spot.
994-3	.....	54,000	111,000	14.0	24.0	.19*, .09	Granular and silky interspersed.
972	.....	53,000	108,000	14.5	37.1	.06, .23*	Do.
994-4	.....	51,000	98,000	22.0	43.3	.11, .33*	Silky.
972-2	.....	48,000	103,000	21.0	30.7	.19*, .23*	Granular; silky center.
1309	2886	43,000	83,000	24.0	40.3	.15, .33*	Silky.
1405	2787	53,000	98,000	12.5	37.1	.07, .18*	Do.
1405-2	2787	52,000	93,000	23.5	43.3	.32*, .15	Do.
1433	.....	40,000	66,500	33.5	64.6	.18, .49*	Fine silky; cup-shaped.
1434	.....	55,500	113,000	11.5	13.2	.09, .14*	Granular.
1475	2784	50,500	102,500	17.0	27.4	.21*, .13	Granular; silky center.
1434-2	.....	55,000	109,000	15.5	24.0	.11, .20*	Silky, 50 per cent; granular, 50 per cent.
1475-2	2784	45,500	95,500	18.0	37.1	.10, .26*	Silky; trace of granulation.
1476	3229	52,000	107,000	16.0	30.7	.11, .21*	Granular; silky center.
1486	.....	50,500	101,500	19.5	37.1	.27*, .12	Silky.
1488	3340	51,000	95,000	24.0	43.3	.16, .32*	Do.
1490	3340	49,000	87,000	25.5	43.3	.32*, .19	Do.
1489	.....	48,000	104,000	14.5	20.5	.10, .19*	Granular; in part silky.
1489-2	.....	51,000	103,500	20.0	30.7	.22*, .18	Silky; trace of granulation.
1551	.....	45,500	94,500	19.0	34.0	.25*, .13	Silky.
1564	.....	54,000	90,500	20.5	40.3	.12, .29*	Do.
972X	.....	57,500	101,500	26.0	51.9	.15, .37*	Fine silky.
972Y	.....	40,500	103,000	12.5	20.5	.15*, .10	Fine granular, radiating from silky spot.
972Z	.....	79,500	138.000	10.0	16.9	.07, .13*	Medium fine granular.
972X2	.....	55,500	103,000	25.5	51.9	.31*, .20	Fine silky.
1573	4389	64,000	128,500	11.0	16.9	.14*, .08	Granular; silky center.
1573-2	4389	49,000	117,000	11.0	16.9	.08, .14*	Granular.
1573-3	4389	52,000	120,500	13.5	20.5	.14*, .13	Granular; silky spot.
1573-4	4389	44,500	109,500	12.5	16.9	.11, .14*	Do.
1573-5	4389	45,500	112,000	11.5	13.2	.12*, .11*	Granular.

6-INCH BARBETTE CARRIAGES.

970	2410	44,000	76,500	29.0	51.9	.18, .40*	Silky
1993	5950	53,000	102,000	11.5	20.5	.07, .16*	Granular, 80 per cent; silky, 20 per cent.
1993-2	5950	50,000	108,500	11.0	16.9	.14, .08	Granular; silky spot.

8-INCH DISAPPEARING CARRIAGES.

985	2435	56,500	90,500	26.5	49.1	.20, .33*	Silky.
1141	.....	55,000	90,500	26.0	49.1	.37*, .15	Fine silky.

10-INCH DISAPPEARING CARRIAGES.

755	.....	39,000	56,500	38.0	62.2	.48*, .28	Fine silky.
756	.....	61,500	103,500	19.5	34 0	.15, .24*	Do.
283	.....	52,500	84,500	19.0	40.3	.27*, .11	Silky.
740-2	1503	54,500	92,500	24.0	54.6	.35*, .13	Do.

FORGED STEEL—Continued.

FROM WATERTOWN ARSENAL SMITH SHOP—Continued.

10-INCH DISAPPEARING CARRIAGES—Continued.

Marks F.	From ingot cast at Watertown Arsenal, number.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
		Pounds.	*Pounds.*	*Per ct.*	*Per ct.*	" "	
742–2	1504	49,500	81,000	23.5	43.3	.36*, .11	Silky.
968	2030	40,500	78,000	28.0	46.2	.34*, .22	Do.
973	.....	40,500	73,500	31.5	51.9	.36*, .27	Do.
982	.....	48,500	79,000	30.5	51.9	.36*, .25	Do.
973–2	.....	50,000	84,000	24.5	54.6	.14, .35*	Do.
973	.....	48,000	86,000	23.5	54.6	.37*, .10	Fine silky.
991	.....	55,500	90,500	23.5	49.1	.34*, .13	Do.
973–4	.....	56,000	90,000	23.0	57.2	.10, .36*	Do.
1004	.....	34,000	59,000	38.0	64.7	.35, .41	Do.
1005	.....	48,500	82,500	28.5	46.2	.36*, .21	Do.
1006	.....	36,000	57,500	36.5	66.9	.52*, .21	Do.
1004–2	.....	53,500	63,500	35.0	66.9	.24, .46*	Do.
1006–2	.....	54,000	64,000	33.0	71.3	.16, .50*	Do.
1323	2788	74,500	139,500	10.0	16.9	.13*, .07	Granular; silky center.
1157	.....	52,500	102,500	16.5	24.0	.16, .17*	Do.
1174	.....	50,500	85,500	21.0	43.3	.29*, .13	Silky.
1230	.....	68,000	133,000	14.5	24.0	.10, .19*	Granular; silky center.
1258	.....	52,000	92,000	24.5	40.3	.24*, .25*	Silky.
1196	2433	53,000	98,000	23.5	43.3	.23*, .24*	Do.
1218	2733	59,500	135,000	13.0	20.5	.17*, .09	Granular; silky center.
1242	2788	42,000	78,500	28.5	51.9	.36*, .21	Fine silky.
1280	2451	49,000	100,500	20.0	34.0	.23*, .17	Silky; trace of granulation.
1303	2782	55,500	102,500	21.5	37.1	.16, .27*	Silky.
1230–2	2788	54,500	119,000	15.0	20.5	.20*, .10	Fine granular; silky center.
1323–2	2788	62,500	129,000	14.0	24.0	.09, .19*	Do.
1430	2822	55,000	87,500	24.5	49.1	.35*, .14	Fine silky.
1230–3	2788	53,500	119,500	14.0	20.5	.11, .17*	Granular.
1174–2	2406	63,000	106,000	18.5	40.3	.09, .28*	Silky.
1218–2	2733	55,500	102,500	21.5	30.7	.19*, .24*	Fine granular.
1242–2	2788	58,500	97,000	24.0	46.2	.31*, .17	Silky.
1442	2822	43,500	89,000	20.5	34.0	.30*, .11	Do.
1445	2822	40,000	87,500	21.5	30.7	.26*, .17	Silky; trace of granulation.
1477	.....	38,500	63,500	36.0	62.2	.49*, .23	Fine silky; cup-shaped.
1478	.....	51,000	66,000	34.5	66.9	.30, .39*	Do.
1479	.....	39,500	65,500	28.0	66.9	.43*, .13	Do.
1480	.....	46,000	68,000	32.5	62.2	.28, .37*	Do.
1230	2788	54,000	119,000	14.0	20.5	.13, .15*	Granular.
1487	.....	41,500	66,500	27.5	62.2	.42*, .13	Fine silky.
1510	3334	57,000	108,000	20.0	34.0	.19*, .21*	Silky.
1516	3281	50,000	82,000	29.0	51.9	.19, .39*	Do.
1524	3283	47,500	98,000	18.0	30.7	.11, .25*	Granular, 60 per cent; silky, 40 per cent.
1527	3339	56,000	112,500	16.5	34.0	.23*, .10	Silky.
1530	3337	60,500	103,500	19.5	37.1	.12, .27*	Do.
1535	3283	46,000	88,000	23.5	40.3	.30*, .17	Do.
1561	3634	51,000	97,500	21.0	30.7	.23*, .19*	Granular; silky on one side.
1545	3230	50,500	87,000	24.5	46.2	.29*, .20	Silky.
1558	3330	49,500	104,000	19.0	27.4	.24*, .14	Granular, 60 per cent; silky, 40 per cent.
1569	3343	43,500	78,500	30.0	51.9	.24, .36*	Silky.
1624	3230	54,000	107,000	19.5	27.4	.14, .25*	Granular; silky center.
303	.....	63,000	99,500	23.5	46.2	.15, .32*	Silky.
1681	4109	45,000	99,000	18.5	30.7	.23*, .14	Silky; granular at circumference.
1684	4089	49,500	106,000	15.5	30.7	.08, .23*	Do.
1687	4090	59,500	125,500	11.0	16.9	.08, .14*	Granular; silky spot.
1545–2	3230	55,300	90,900	26.5	51.9	.16, .37*	Fine silky.
1693	4830	41,000	90,500	19.5	27.4	.14, .25*	Granular, 60 per cent; silky, 40 per cent.
1684–2	4089	46,500	106,000	15.0	20.5	.19*, .11	Do.
1687–2	4090	46,000	112,500	11.0	13.2	.10*, .12*	Granular.
1693–2	4830	46,000	97,500	15.5	27.4	.20*, .11	Granular, 50 per cent; silky, 50 per cent.
1729	4283	33,000	72,000	27.5	46.2	.37*, .18	Silky.
1731	5043	43,000	104,500	13.5	20.5	.18*, .09	Granular; silky spot.

FORGED STEEL—Continued.

FROM WATERTOWN ARSENAL SMITH SHOP—Continued.

10-INCH DISAPPEARING CARRIAGES—Continued.

Marks F.	From ingot cast at Watertown Arsenal. number.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
		Pounds.	*Pounds.*	*Per ct.*	*Per ct.*	" "	
1734	5044	56,000	104,000	18.0	37.1	.10, .26*	Silky; trace of granulation.
1727	4110	41,000	77,000	27.0	43.3	.20, .34*	Silky.
1684-3	4689	46,000	98,000	21.0	34.0	.15, .27*	Silky; trace of granulation.
1687-3	4690	42,000	108,000	13.0	13.2	.13*, .13*	Granular.
1729-2	4283	54,000	95,500	21.0	46.2	.31*, .12	Fine silky.
1693-3	4830	50,500	92,500	22.5	34.0	.23*, .22*	Silky.
1727-2	4110	54,000	103,000	18.0	37.1	.23*, .13	Do.
1748	4109	55,500	72,000	31.5	51.9	.23, .40*	Do.
1731-2	5043	45,000	99,500	19.0	27.4	.19*, .19*	Granular; silky spot.
1763	5321	46,000	94,500	16.5	24.0	.20*, .13	Do.
1762	5321	50,500	99,500	17.0	34.0	.09, .25*	Granular and silky metal interspersed.
1791	5321	52,000	107,000	16.0	27.4	.22*, .10	Granular; silky spot.
1769	5527	34,000	71,500	29.5	46.2	.24, .35*	Silky; oblique.
1769-2	5527	33,000	72,500	27.5	46.2	.17, .38*	Fine silky.
1748-2	4109	51,500	83,000	25.0	59.8	.25*, .25*	Do.
1687-4	4690	53,500	114,500	15.0	20.5	.15, .15*	Granular; silky spot.
1748-3	4109	48,500	79,000	28.5	57.2	.15, .42*	Silky.
1748-4	4109	48,500	82,000	27.5	57.2	.39*, .16	Do.
1769-3	5527	44,500	85,000	21.0	37.1	.20, .22*	Do.
1687-5	4690	39,000	95,000	19.5	27.4	.20*, .19*	Granular.
1687-6	4690	39,000	94,000	21.0	34.0	.16, .26*	Granular; silky center.

12-INCH DISAPPEARING CARRIAGES.

908	.....	54,500	92,500	25.0	49.1	.35*, .15	Fine silky.
1230-3	2788	45,500	108,000	14.5	24.0	.07, .22*	Granular.
1522	3282	58,500	100,500	22.0	37.1	.21*, .23*	Fine silky.
1541	3343	47,500	80,000	30.0	54.6	.23, .37*	Silky.
1554	3282	44,000	76,500	29.5	51.9	.39*, .20	Fine silky.
1562	4112	47,000	93,000	21.5	40.3	.13, .30*	Silky.
1565	2785	62,000	118,500	15.0	27.4	.09, .21*	Granular; silky spot on side.
1543	2405	38,000	77,500	25.0	40.3	.32*, .18	Silky.
1627	4281	34,500	64,500	28.5	46.2	.21, .36*	Do.
1635	4109	38,000	87,500	20.0	24.0	.16, 24*	Silky, 40 per cent; granular 60 per cent.
1648	4113	42,500	88,000	20.5	37.1	.11, .30*	Silky; trace of granulation.
1657	3335	43,000	103,500	12.0	13.2	.08, .16*	Granular.
1667	3826	54,500	116,000	13.5	20.5	.17*, .10	Granular; silky center.
1672	4280	28,500	63,000	31.0	43.3	.20, .42*	Silky.
1682	4385	36,000	73,000	28.0	49.1	.26*, .30*	Fine silky.
1627-2	4281	45,000	78,500	23.5	46.2	.25*, .22	Silky; oblique.
1635-2	4109	46,500	93,000	18.0	24.0	.15, .21*	Granular; silky spot.
1648-2	4113	48,000	93,000	22.5	37.1	.25*, .20*	Silky.
1672-2	4280	44,000	78,000	29.0	59.8	.35*, .23	Fine silky.
1657-2	3335	38,000	101,000	15.0	16.9	.17*, .13	Granular.
1667-2	3826	37,500	101,000	13.0	16.9	.12*, .14*	Do.
1699	3614	57,000	114,500	11.0	20.5	.15*, .07	Granular at circumference: silky center.
1682-2	4385	41,000	72,000	25.5	46.2	.15, .36*	Silky.
1690-2	3614	38,000	74,000	23.0	34.0	.29*, .17	Do.
1724-2	3614	46,000	101,500	16.0	27.4	.10, .22*	Granular circumference; silky center.
1672-3	4280	52,500	80,000	23.0	54.6	.10, .36*	Silky.
1627-3	4281	53,500	90,000	20.0	46.2	.29*, .11	Do.
1726	3612	56,000	108,000	17.0	30.7	.11, .23*	Granular, 70 per cent; silky, 30 per cent.
1725-3	3614	42,500	97,500	17.5	20.5	.19*, .16*	Granular; silky spot.
1690	3614	40,500	77,000	17.0	20.5	.15, .19*	Do.
1682-3	4385	44,500	72,500	28.5	51.9	.15, .42*	Fine silky.
1690-3	3614	45,000	79,500	28.5	49.1	.37*, .20	Do.
1657-3	3335	48,000	102,500	16.5	40.3	.26*, .07	Silky; trace of granulation.

FORGED STEEL—Continued.

FROM WATERTOWN ARSENAL SMITH SHOP—Continued.

12-INCH DISAPPEARING CARRIAGES—Continued.

Marks F.	From ingot cast at Watertown Arsenal, number.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
		Pounds.	*Pounds.*	*Per ct.*	*Per ct.*	" "	
1667-3	3826	51,000	109,500	18.5	30.7	.23*, .14	Silky center; granular at circumference.
1723-4	3614	41,500	72.000	30.0	40.3	.37*, .23	Fine silky.
1682-4	4385	52,000	93,000	23.0	51.9	.16, .30*	Silky.
1723-5	3614	49,500	77,000	29.0	57.2	.40*, .18	Fine silky.
1966	3810	44,500	81,500	28.0	46.2	.36*, .20	Silky.

12-INCH MORTAR CARRIAGES.

1622	3,826	44,500	105,000	17.0	27.4	.23*, .11	Silky and granular.
1772	5,527	30,500	70,000	25.5	37.1	.24, .27*	Silky.
1772-2	5,527	34,000	77,000	28.0	49.1	.38*, .18	Fine silky.
1792	5,942	54,000	100,500	21.0	40.3	.30*, .12	Silky.
1808	5,527	42,500	88,500	21.5	37.1	.29*, .14	Do.
1813	4,942	55,500	96,000	21.5	37.1	.21*, .22*	Do.
1833	3,825	59,500	121,000	16.0	24.0	.14, .18*	Granular; silky spot.
1884	5,948	40,500	87,000	20.0	37.1	.29*, .11	Silky.
1900	5,189	56,000	108,500	20.0	37.1	.24*, .16	Do.
1916	6,105	53,000	89,500	26.5	49.1	.36*, .17	Do.
1943	5,948	47,500	80,000	27.5	49.1	.17, .38*	Do.
1772-3	5,527	47,000	84.500	24.5	49.1	.15, .34*	Do.
1949	6,106	60,500	108,000	14.5	27.4	.08, .21*	Granular; silky center.
1956	5,950	67,500	113,000	15.0	27.4	.22*, .08	Do.

MISCELLANEOUS.

957	3,051	43,500	73,500	31.0	62.2	.30*, .32*	Fine silky.
957-2	3,051	116,500	132,000	15.0	62.2	.01, .29*	Do.
969	2,435	43,000	84,000	25.0	37.1	.18, .32*	Silky; trace of granulation.
969-2	2,435	47,000	88,000	26.0	46.2	.24, .28*	Silky.
980	2,453	48,000	83,000	27.0	43.3	.24, .30*	Do.
1153	2,733	50,500	93,000	22.0	34.0	.28*, .16	Do.
1154	2,754	53,000	102,000	20.0	34.0	.23*, .17	Silky; trace of granulation.
1155	.....	53,000	99,500	18.0	30.7	.22*, .14	Granular and silky interspersed.
1156	.....	53,000	71,000	34.0	62.2	.24, .42*	Fine silky.
1378	.....	49,500	71,500	22.0	49.1	.10, .34*	Do.
1398	2,886	44,500	84,000	24.0	37.1	.27*, .21	Silky.
1448	2,789	59,000	115,500	15.5	30.7	.09, .22*	Silky; trace of granulation.
P. O. 1831-1	.....	34,000	69,500	31.0	57.2	.36*, .26	Silky.
P. O. 1831-2	.....	55,000	108,000	20.0	37.1	.20*, .20*	Do.

FROM CAMDEN FORGE COMPANY.

6-INCH DISAPPEARING CARRIAGE.

G. L. A. 1-25	.....	42,000	92,500	17.0	34.0	.25*, .09	Silky, with granular metal interspersed.
G. L. A. 2-25	.....	43,000	90,500	24.0	34.0	.28*, .20	Silky.
G. L. A. 26	.....	46,500	99,500	20.0	34.0	.23*, .17	Do.

CAST IRON, TENACITY SPECIMENS.

TENSION TESTS OF CAST IRON.

Tenacity specimens, excepting those having elongation given, which latter had stems 6″ or 10″ long each.

FROM WATERTOWN ARSENAL FOUNDRY.

No. of heat.	Description.	Elongation of 0.25 per cent at load per square inch of—	Tensile strength per square inch.	Appearance of fracture.
		Pounds.	*Pounds.*	
319	6-inch disappearing carriages.	.....	30,000	Granular; gray.
322	.....do.....	.....	29,000	Do.
324	.....do.....	.....	32,000	Do.
326	.....do.....	.....	37,500	Do.
328	.....do.....	.....	31,000	Do.
338	.....do.....	.....	27,000	Do.
344	.....do.....	.....	30,500	Do.
338	.....do.....	.....	28,500	Fine granular; gray.
357	.....do.....	.....	29,600	Do.
365	.....do.....	.....	31,500	Do.
380	.....do.....	.....	31,000	Do.
384	.....do.....	.....	32,500	Do.
318	10-inch disappearing carriages.	.....	30,500	Granular; gray.
325	.....do.....	.....	32,000	Do.
327	.....do.....	27,100	33,000	Granular; light gray.
327	.....do.....	.....	31,200	Granular; gray.
327	.....do.....	.....	30,400	Do.
329	.....do.....	.....	29,400	Do.
329	.....do.....	.....	30,000	Do.
329	.....do.....	26,500	32,500	Do.
330	.....do.....	.....	34,000	Do.
331	.....do.....	27,800	34,600	Granular; light gray.
331	.....do.....	.....	32,100	Do.
331	.....do.....	.....	32,600	Do.
332	.....do.....	26,000	33,500	Do.
332	.....do.....	.....	31,600	Do.
332	.....do.....	.....	32,500	Do.
334	.....do.....	27,100	34,200	Do.
334	.....do.....	.....	31,700	Granular; gray.
334	.....do.....	.....	35,300	Do.
334	.....do.....	.....	34,300	Granular; light gray.
334	.....do.....	.....	35,200	Do.
336	.....do.....	27,400	33,600	Granular; gray.
336	.....do.....	.....	34,400	Do.
336	.....do.....	.....	35,000	Do.
337	.....do.....	27,200	34,500	Do.
337	.....do.....	.....	32,700	Fine granular; gray.
337	.....do.....	.....	32,400	Do.
339	.....do.....	26,100	33,500	Do.
339	.....do.....	.....	30,800	Do.
339	.....do.....	.....	32,400	Do.
341	.....do.....	26,500	33,400	Do.
341	.....do.....	.....	35,100	Do.
341	.....do.....	.....	35,100	Do.
343	.....do.....	27,200	33,400	Granular; gray.
343	.....do.....	.....	33,800	Do.
343	.....do.....	.....	33,200	Do.
346	.....do.....	27,000	33,800	Fine granular; gray.
346	.....do.....	.....	30,500	Do.
346	.....do.....	.....	32,100	Do.
352	.....do.....	.....	34,500	Do.
351	.....do.....	26,800	35,400	Do.
351	.....do.....	.....	37,500	Do.
351	.....do.....	.....	37,100	Do.
356	.....do.....	26,300	33,900	Do.
356	.....do.....	.....	35,700	Do.
356	.....do.....	.....	34,800	Do.
361	.....do.....	.....	35,500	Do.
360	.....do.....	26,900	35,700	Do.
360	.....do.....	.....	34,200	Do.
360	.....do.....	.....	32,900	Do.
370	.....do.....	.....	31,500	Do.
369	.....do.....	25,100	31,200	Do.
369	.....do.....	.....	34,700	Do.
360	.....do.....	.....	32,600	Do.
370	.....do.....	.....	34,000	Do.
376	.....do.....	.....	31,070	Do.

TENSION TESTS OF CAST IRON—Continued.

FROM WATERTOWN ARSENAL FOUNDRY—Continued.

No. of heat.	Description.	Elongation of 0.25 per cent at load per square inch of—	Tensile strength per square inch.	Appearance of fracture.
		Pounds.	*Pounds.*	
382	.....do.....	27,300	35,400	Fine granular; light gray.
382	.....do.....	.....	30,100	Fine granular; gray.
382	.....do.....	.....	31,400	Do.
386	.....do.....	.....	32,500	Fine granular; gray; dark spot.
388	.....do.....	27,900	35,800	Fine granular; gray.
320	12-inch disappearing carriages.	.....	30,000	Granular; gray.
321	.....do.....	.....	29,000	Do.
323	.....do.....	.....	29,500	Do.
335	.....do.....	.....	30,000	Do.
340	.....do.....	.....	39,000	Fine granular; gray.
342	.....do.....	.....	33,000	Do.
347	.....do.....	.....	28,500	Do.
348	.....do.....	.....	24,530	Do.
349	.....do.....	.....	25,050	Do.
350	.....do.....	.....	26,530	Do.
353	.....do.....	.....	29,170	Do.
354	.....do.....	.....	26,100	Do.
355	.....do.....	.....	28,040	Do.
358	.....do.....	.....	29,200	Do.
359	.....do.....	.....	25,800	Do.
362	.....do.....	.....	20,940	Do.
362	.....do.....	.....	27,930	Do.
363	.....do.....	.....	27,680	Do.
366	.....do.....	.....	32,550	Do.
364	.....do.....	25,500	32,600	Do.
367	.....do.....	.....	31,000	Do.
364	.....do.....	.....	32,100	Do.
364	.....do.....	.....	33,900	Do.
368	.....do.....	.....	26,910	Do.
371	.....do.....	.....	28,420	Do.
372	.....do.....	.....	20,830	Fine granular; gray; blow holes.
372	.....do.....	.....	29,020	Fine granular; gray.
374	.....do.....	.....	32,500	Do.
377	.....do.....	.....	31,000	Do.
375	.....do.....	26,700	33,600	Granular; gray.
375	.....do.....	.....	37,900	Fine granular; gray.
375	.....do.....	.....	34,800	Do.
378	.....do.....	27,400	35,100	Do.
378	.....do.....	.....	38,000	Do.
378	.....do.....	.....	37,500	Do.
379	.....do.....	27,800	35,800	Do.
379	.....do.....	.....	29,000	Fine granular; gray; two smooth globular spots.
379	.....do.....	.....	34,600	Fine granular; gray.
383	.....do.....	.....	34,000	Do.
385	.....do.....	28,300	36,700	Do.
385	.....do.....	.....	34,100	Do.
387	.....do.....	.....	28,000	Do.
387	.....do.....	.....	37,100	Do.
389	.....do.....	27,700	35,900	Do.
389	.....do.....	.....	32,800	Do.
389	.....do.....	.....	33,900	Do.
390	.....do.....	27,200	36,400	Do.
390	.....do.....	.....	34,600	Do.
390	.....do.....	.....	36,100	Do.
392	12-inch mortar carriages.	.....	32,000	Do.
393	.....do.....	.....	31,000	Do.
394	.....do.....	.....	37,000	Do.
395	.....do.....	.....	34,500	Do.
396	.....do.....	.....	29,500	Do.

TENSION TESTS OF CAST IRON—Continued.

FROM C. H. COWDREY MACHINE COMPANY.

Marks.	Tensile strength per square inch.	Appearance of fracture.
	Pounds.	
1-2	32,000	Fine granular; gray.

FROM RICHMOND IRON WORKS.

Description.	Elongation at maximum load.	Tensile strength per square inch.	Appearance of fracture
	Per cent.	*Pounds.*	
Brake-shoe casting	0.50	29,100	Medium granular; gray.

BRONZE.

BRONZE.

The elastic limits stated are approximations, and signify the loads at which the specimens showed increased rates of elongation.

From Watertown Arsenal.

15-POUNDER GUN CARRIAGES.

Marks.	Approximate elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Pounds.	*Pounds.*	*Per ct.*	*Per ct.*	" "	
1963	.....	42,500	25.5	23.9	.26, .25*	Light yellow.
2814	.....	33,500	4.5	5.7	.05*, .04	Lavender.
2870	.....	26,500	9.5	13.2	.11*, .08	Lavender and light yellow.
2870-2	.....	27,500	10.0	9.5	.11*, .09	Do.
3030	.....	30,500	5.0	9.5	.08*, .02	Do.
4750	.....	71,000	21.5	20.5	.23*, .20	Light yellow.

6-INCH DISAPPEARING CARRIAGES.

2601	29,500	74,000	21.0	23.9	.23*, .19	Dark and light yellow.
2659	31,500	74,000	12.5	9.5	.11, .14*	Light and lemon yellow.
2810	31,000	76,000	29.0	30.7	.32*, .26	Light yellow.
2823	33,000	76,000	30.5	30.7	.27, .34*	Do.
2827	30,000	74,000	29.5	30.7	.29, .30*	Do.
2944	.....	65,500	12.0	13.2	.10, .14*	Light yellow; columnar.
2969	.....	35,500	3.0	1.8	.01, .05*	Lavender and lemon yellow.
2986	.....	57,500	6.0	9.5	.05, .07	Light yellow; columnar.
3007	.....	64,500	6.0	9.5	.06, .06*	Lavender and lemon yellow.
2969-2	.....	65,500	8.0	13.2	.06, .10*	Light yellow; columnar.
3054	.....	57,500	3.0	5.7	.04*, .02	Do.
3097	.....	73,500	18.0	23.9	.17, .19*	Light yellow.
3097-2	.....	67,500	13.5	20.5	.12, .15*	Do.
3113	.....	74,000	9.0	9.5	.08, .10*	Do.
3134	.....	67,500	15.0	20.5	.17*, .13	Do.
3157	.....	68,500	15.0	20.5	.16*, .14	Do.
3180	.....	71,500	13.5	20.5	.15*, .12	Do.
3189	.....	64,000	4.5	5.7	.06*, .03	Light yellow; irregular.
3201	.....	56,500	3.5	9.5	.02, .03*	Do.
3227	.....	64,500	17.0	20.5	.14, .20*	Light yellow.
3227-2	.....	66,000	19.0	27.4	.21*, .17	Do.
3248	.....	62,500	6.0	13.2	.05, .07*	Light yellow; columnar.
3280	.....	41,000	5.5	9.5	.08*, .03	Lavender and lemon yellow.
3280-2	.....	65,500	17.5	24.0	.15, .20*	Light yellow; columnar.
3339	.....	57,000	16.0	20.5	.18*, .14	Light yellow and lemon.
3374A	.....	60,500	9.5	20.5	.07, .12*	Light yellow.
3374B	.....	71,000	25.5	24.0	.27*, .24	Do.
3354	.....	51,000	11.0	20.5	.10, .12*	Lavender and lemon yellow.
3374R	.....	71,500	25.5	27.4	.27*, .24	Light yellow.
3350-2	.....	25,500	3.0	5.7	0, .06*	Lemon yellow.
3390A	.....	71,500	20.0	24.0	.22*, .18	Light yellow.
3339-2	.....	64,000	22.0	27.4	.24, .30*	Do.
3355-3	.....	64,000	23.5	30.7	.29, .18	Light yellow; columnar.
3415	.....	54,500	15.0	30.7	.13, .17*	Lemon yellow and lavender.
3422	.....	66,500	8.0	9.6	.10*, .06	Light yellow.
3415-2	.....	54,000	18.5	30.7	.22*, .15	Do.
3529	31,000	70,500	19.0	20.5	.18, .20*	Do.
3900BK	26,000	70,000	24.0	30.7	.21, .27*	Do.
3911BK	.....	71,000	33.5	34.0	.34*, .33*	Do.
3921	25,500	71,500	33.0	34.0	.36*, .30	Do.
3933	.....	73,000	31.0	34.0	.31*, .31*	Do.
3939	.....	62,500	23.5	24.0	.20, .27*	Do.
3951	24,500	67,000	37.0	37.1	.41*, .33	Do.
3966	.....	67,000	15.5	20.5	.17*, .14	Do.
3969	.....	67,500	9.0	13.2	.07, .11*	Do.
3979	.....	66,500	21.0	27.4	.20, .22*	Do.
3981	.....	62,000	26.0	30.7	.28*, .24	Do.
3983	.....	67,000	8.0	9.6	.08*, .08	Do.
3986	.....	70,500	16.5	16.9	.15*, .08	Do.
3993	.....	64,000	26.0	27.4	.28*, .24	Do.
4069	.....	52,000	18.0	20.5	.18*, .18*	Dark yellow.
4078	.....	59,000	31.5	34.0	.35*, .28	Yellow.
4097	.....	61,000	20.3	30.7	.21, .25*	Light yellow; brownish tinge in center.
3529A2	30,000	74,500	26.0	30.7	.23, .29*	Light yellow.
4251	.....	58,500	27.0	27.4	.28*, .26	Dark yellow.
4136-4	.....	57,000	14.0	20.5	.14*, .14	Light yellow.

From Watertown Arsenal—Continued.

6-INCH RAPID-FIRE GUN CARRIAGES.

Marks.	Approximate elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Pounds.	*Pounds.*	*Per ct.*	*Per ct.*	" "	
4276–1	.....	42,500	10.0	13.2	.10*, .10*	Light lavender.
4297–1	.....	50,500	15.5	16.9	.16*, .15*	Do.
4316A	.....	54,000	24.0	24.0	.21*, .27*	Light yellow.
4337A	.....	45,000	8.5	16.9	.07, .10*	Dark yellow.
4356A	.....	33,000	13.0	20.5	.14*, .12	Light lavender.
4356–2	.....	51,500	14.5	16.9	.14*, .15	Do.
4276–2	.....	43,000	10.5	13.2	.10*, .11*	Do.
4531	.....	52,000	15.5	24.0	.16*, .15	Light yellow.

6-INCH BARBETTE CARRIAGES.

967F	.....	64,800	36.0	55.8	.23, .49*	Silky; light yellow.
995F	.....	72,500	22.5	54.6	.35*, .10	Fine silky; light yellow; cup-shaped.
995F	.....	67,400	29.5	54.2	.43*, .16	Fine silky; light yellow.

10-INCH DISAPPEARING CARRIAGES.

1486–2	.....	48,000	30.5	34.0	.34*, .27	Brownish yellow.
2040–1	.....	77,500	26.5	30.7	.27*, .26	Light yellow.
2156	.....	43,000	20.0	16.9	.21, .19*	Dark lavender.
2059	.....	76,000	24.0	30.7	.26*, .22	Light yellow.
2096	.....	73,000	20.0	27.4	.22*, .18	Do.
2101	35,000	73,000	19.0	30.7	.17, .22*	Do.
2165	30,000	75,500	25.5	23.9	.28*, .23	Do.
2168	.....	37,000	10.5	13.2	.12*, .09	Lavender.
2183	30,000	77,000	25.0	23.9	.25*, .25*	Light yellow.
2186	30,500	73,500	22.0	23.9	.20, .24*	Do.
2189	.....	35,000	12.0	13.2	.12, .12	Light yellow and lavender.
2193	31,500	71,000	16.5	23.9	.14, .19*	Light yellow.
2199	32,000	74,500	21.5	23.9	.20, .23*	Do.
2212	.....	33,000	8.5	9.5	.09, .08	Lavender.
2217	31,000	77,500	27.5	27.4	.26, .29*	Light yellow.
2218	30,000	75,000	25.0	27.4	.26*, .24	Do.
2219	29,000	74,500	28.5	27.4	.30*, .27	Do.
2220	28,500	72,000	22.5	20.5	.25*, .20	Do.
2253	.....	36,000	18.0	13.2	.17, .19*	Light yellow and lavender.
2280	.....	44,500	37.0	34.0	.22, .41*	Light yellow.
2281	.....	47,000	40.5	37.1	.47*, .34	Do.
2212–2	.....	34,000	11.0	20.5	.15*, .07	Lavender and light yellow.
2203	.....	42,500	36.0	37.1	.40*, .32	Light yellow.
2304–2	.....	50,500	33.5	34.0	.34*, .33	Brownish yellow.
2305–2	.....	40,500	26.5	23.9	.30*, .23	Do.
2306	.....	52,500	14.5	20.5	.16*, .13	Light lavender and lemon yellow.
2368	.....	59,000	19.0	20.5	.19*, .19	Light lavender.
2378	.....	31,000	2.5	5.7	.04*, .01	Light lavender and lemon yellow.
2331	.....	57,000	16.5	20.5	.17*, .16	Light lavender.
2378–2	.....	61,500	22.0	27.4	.19, .25*	Light yellow.
2420	.....	57,000	21.0	23.9	.19, .23*	Lavender and light yellow.
2469	.....	63,000	16.5	20.5	.18*, .15	Light yellow.
2630	.....	62,000	25.0	23.9	.30*, .20	Do.
2647	.....	63,500	24.0	30.7	.21, .27*	Do.
2665	.....	63,500	16.5	16.9	.18*, .15	Do.
2698	.....	58,000	14.5	16.9	.12, .17*	Do.
2746	.....	58,500	22.5	30.7	.21, .24*	Brownish yellow.
2778	.....	55,000	16.0	13.2	.19*, .13	Light yellow.
2785	.....	60,000	8.5	9.5	.08, .09*	Do.
2831	30,000	67,500	16.5	20.5	.14, .19*	Do.
2829	.....	41,500	3.0	1.8	.01, .05*	Dark and lemon yellow.
2916	.....	72,000	19.0	20.5	.19*, .19	Light yellow.
2917–2	.....	75,500	29.0	27.4	.25, 33	Do.
2883	28,000	67,000	15.0	20.5	.13, .17*	Do.
2967	29,500	41,500	4.0	9.5	.05*, .03	Light and lemon yellow.

From Watertown Arsenal—Continued.

10-INCH DISAPPEARING CARRIAGES—Continued.

Marks.	Approximate elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Pounds.	*Pounds.*	*Per ct.*	*Per ct.*	" "	
2884-2	26,500	66,000	15.0	20.5	17*, .13	Light yellow.
2968-2	34,000	46,500	2.5	0.	03, .02	Light and lemon yellow.
2832-2	.....	68,500	17.0	23.9	19*, .15	Light yellow.
3075	.....	58,000	2.5	5.7	.14*, .01	Light yellow; columnar.
2829-2	31,000	83,000	18.0	20.5	.17, .19*	Light yellow.
3090	.....	37,500	8.0	9.5	.09*, .07	Lavender.
3269	.....	46,000	29.0	23.9	.26, .32*	Dark yellow.
3389-4	41,000	71,000	19.5	24.0	.18, .21*	Light yellow.
3388	38,000	69,000	19.5	20.5	.18, .21*	Do.
3390B	.....	72,500	31.5	30.7	.30, .33*	Do.
3409-2	.....	70,500	26.0	27.4	.23, .29*	Do.
3409-3	.....	69,500	25.0	27.4	.23, .27*	Do.
3410-1	.....	70,000	25.0	24.0	.27*, .23	Do.
3410-3	.....	66,000	17.5	20.5	.16, .19*	Do.
3540	.....	55,500	8.5	13.2	.06, .11*	Do.
3554B	.....	62,000	16.0	20.5	.14, .18*	Do.
3564B	.....	61,500	19.5	24.0	.18, .21*	Do.
3538S2	.....	70,500	25.0	30.7	.22, .28*	Do.
3540S2	.....	71,000	25.5	27.4	.28*, .23	Do.
3568F	.....	29,000	2.5	5.7	.01, .04*	Lavendar and lemon yellow.
3573B	.....	62,500	10.0	13.2	.09, .11*	Brownish yellow.
3627A	.....	63,500	14.5	16.9	.15, .14	Light yellow.
3628A	.....	59,000	10.5	13.2	.09, .12*	Do.
3641A	31,000	51,000	5.0	9.6	.04, .06	Light and lemon yellow; cavity.
3642S	27,000	71,500	28.0	30.7	.30*, .26	Light yellow; oblique.
3627S2	.....	71,000	27.5	30.7	.26, .29*	Light yellow.
3628S2	.....	71,000	26.5	27.4	.28*, .25*	Do.
3643S	28,500	72,000	28.5	30.7	.26, .31*	Do.
3700B	.....	35,500	25.0	27.4	.26*, .24	Light golden yellow.
3811S	29,500	67,000	26.5	24.0	.27*, .26	Light yellow; oblique.
3812S	31,500	69,000	22.0	24.0	.25*, .19	Light yellow.
3833S2	.....	67,000	15.0	.....	.14, .16*	Brown and yellow; broke in head.
3833BK3	.....	70,500	26.0	30.7	.28*, .24	Light yellow.
3106	.....	35,500	7.5	13.2	.05, .10*	Light yellow and lavender.
2682	.....	54,500	14.0	16.9	.15*, .13	Brownish yellow.
3629A	.....	65,000	14.5	16.9	.15*, .14	Light yellow.
3633A	28,500	67,000	20.0	27.4	.18, .22*	Do.
3630A2	.....	67,000	17.5	20.5	.19*, .16	Do.
3645A	.....	62,500	19.0	24.0	.21*, .17	Do.
3630-3	.....	44,500	4.5	9.6	.03, .06*	Lavender and lemon yellow.
3646A2	.....	63,500	19.5	24.0	.16, .23	Light yellow.
3630-4	.....	69,000	21.0	20.5	.24*, .18	Do.
3814B	.....	69,500	34.0	37.1	.39*, .29	Light yellow; oblique.
4237	.....	50,500	22.5	24.0	.22, .23*	Dark yellow.
4637	.....	65,000	36.0	37.1	.38*, .34	Light yellow.
4643	.....	65,500	31.5	30.7	.32*, .31	Do.
4680	.....	62,000	35.5	37.1	.35, .36*	Do.
4734	.....	26,000	7.0	1.8	.09, .05	Gray and dark yellow.
4734-2	.....	21,000	4.0	5.7	.04, .04*	Dark lavender.

12-INCH DISAPPEARING CARRIAGES.

1932	.....	29,000	4.5	5.7	.06*, .03	Lemon yellow.
1932-2	22,500	30,500	8.0	13.2	.09*, .07	Lavender.
3449	.....	65,500	14.5	16.9	.17*, .12	Light yellow.
3538S	.....	66,500	19.0	24.0	.20*, .18	Do.
3742BK	.....	35,500	24.5	20.5	.25*, .24	Dark yellow.
3859BK3	.....	69,500	22.5	20.5	.19, .26*	Light yellow.
3880BK	.....	69,000	30.0	34.0	.28, .32*	Do.
3887BK	.....	67,000	39.0	37.1	.39*, .39*	Light yellow; oblique.
3894BK	.....	71,000	36.0	37.1	.40*, .32	Light yellow.
3917	.....	71,000	25.5	27.4	.26*, .25	Do.
3975	.....	64,500	7.5	9.6	.08*, .07	Do.
3975	.....	65,000	8.5	9.6	.08, .09*	Do.
4005	.....	62,500	29.5	30.7	.29, .30*	Do.
4007	.....	66,000	29.0	30.7	.31*, .27	Do.
4015	.....	35,000	25.0	27.4	.28*, .22	Do.
4020	.....	58,500	28.5	34.0	.25, .32*	Do.

From Watertown Arsenal—Continued.

12-INCH DISAPPEARING CARRIAGES—Continued.

Marks.	Approximate elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Pounds.	*Pounds.*	*Per ct.*	*Per ct.*	" "	
4039	.....	59,000	29.0	30.7	.27, .31*	Light yellow.
4040	.....	61,000	27.0	27.4	.26*, .28*	Do.
4057	21,000	69,000	34.0	34.0	.35*, .33*	Light yellow; oblique.
4062	26,000	72,500	33.5	34.0	.31, .36*	Light yellow.
4082	.....	57,500	21.5	24.0	.20, .23*	Light and medium yellow.
4109	.....	59,180	31.5	34.0	.30, .33*	Light yellow.
3844B	.....	64,000	10.5	13.2	.09, .12*	Light yellow; irregular.
3863B	.....	63,500	13.5	24.0	.16*, .11	Do.
4035	.....	58,000	28.5	27.4	.30*, .27	Light yellow.
4123	.....	50,500	14.0	16.9	.13*, .15*	Dark yellow.
4134	23,000	67,500	30.0	34.0	.26, .34*	Light golden yellow.
4144	.....	35,500	21.0	16.9	.19, .23*	Dark yellow.
4154	.....	36,500	23.5	24.0	.22, .25*	Light yellow.
4148	21,000	68,500	32.0	30.7	.35*, .29	Do.
4161	.....	71,500	29.0	34.0	.30*, .28*	Do.
4165	27,000	69,500	25.0	27.4	.22, .28*	Do.
4190	26,000	72,500	32.5	30.7	.30, .35*	Do.
4175	22,000	68,000	21.0	27.4	.19, .23*	Do.
4181	22,500	72,000	28.0	27.4	.26, .30*	Do.
4185	.....	71,500	33.0	30.7	.30, .36*	Do.
4193	.....	73,000	31.5	34.0	.32*, .31*	Do.
4199	24,000	72,000	28.5	30.7	.30*, .27	Do.
4209	25,000	72,000	29.5	30.7	.27, .32*	Do.
4135–3	.....	29,500	2.5	9.6	0., .05*	Greenish yellow, 60 per cent; light yellow, 40 per cent.
4173–2	.....	64,000	8.0	9.6	.07, .09*	Light yellow; coarse granular.
4221	.....	71,500	27.5	30.7	.31*, .24	Light yellow.
4158–2	.....	36,000	4.0	9.6	.06*, .02	Light and lemon yellow.
4173–3	.....	58,500	7.0	9.6	.05, .09*	Light yellow; coarse granular.
4158–4	.....	57,500	12.0	20.5	.14*, .10	Light and lemon yellow.
4243	.....	71,500	29.0	27.4	.27, .31*	Light yellow.
4248	.....	71,000	30.5	34.0	.30, .31*	Do.
4377	.....	68,000	12.5	20.5	.11, .14*	Do.
4379	.....	71,500	31.0	37.1	.32*, .30	Do.
4402	.....	70,000	33.5	34.0	.30, .37*	Do.
4412	.....	68,500	32.5	34.0	.30, .35*	Do.
4416	.....	68,500	33.5	34.0	.32, .35*	Do.
4421	.....	68,000	35.5	34.0	.40*, .31	Do.
4434	.....	67,500	38.5	37.1	.45*, .32	Do.
4445	.....	67,000	32.5	34.0	.30, .35*	Do.
4452	.....	67,000	34.5	34.0	.33, .36*	Do.
4465	.....	63,500	22.5	30.7	.20, .25*	Do.
4474	.....	67,000	35.0	34.0	.31, .39*	Do.
4477	.....	65,500	41.5	40.3	.36, .47*	Do.
4173	.....	62,500	7.0	13.2	.06, .08*	Light yellow; coarse granular.
4562	.....	68,000	28.5	30.7	.26, .31*	Light yellow.
4567	.....	69,000	30.0	34.0	.28, .32*	Do.
4575	.....	65,500	37.0	37.1	.40*, .34	Do.
4599	.....	66,500	35.0	37.1	.38*, .32	Do.
4604	.....	65,000	37.5	37.1	.33, .42*	Do.
4735	.....	71,000	10.5	13.2	.11, .10	Do.
4735–2	.....	57,500	9.5	16.9	.10, .09	Lavender; yellow spot.

12-INCH MORTAR CARRIAGES.

1545	.....	34,500	8.5	20.5	.05, .12*	Light yellow and trace of lavender.
1545–2	.....	46,000	31.0	27.4	.30*, .32	Do.
4480	.....	68,500	30.5	27.4	.33*, .28	Light yellow.
4483	.....	67,000	37.0	37.1	.32, .42*	Do.
4486	.....	64,200	41.0	40.3	.39, .43*	Do.
4500	.....	67,500	32.5	34.0	.29, .36*	Do.
4503	.....	68,000	30.5	34.0	.33*, .28	Do.
4532	.....	66,000	33.5	37.1	.31, .36*	Do.
4510	.....	61,000	4.5	9.6	.05*, .04	Lemon yellow.
4516	.....	66,500	32.0	34.0	.34*, .30	Light yellow.
4540	.....	66,000	40.0	40.3	.45*, .35	Do.
4546	.....	66,000	40.5	43.3	.36*, .45*	Do.
4554	.....	67,000	40.5	40.3	.39, .42*	Do.

From Watertown Arsenal—Continued.

12-INCH MORTAR CARRIAGES—Continued.

Marks.	Approximate elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Pounds.	*Pounds.*	*Per ct.*	*Per ct.*	" "	
4560	.....	62,000	23.0	30.7	.21, .25*	Light yellow.
4561	.....	65,500	36.0	37.1	.32, .42*	Do.
4565	.....	67,000	37.5	37.1	.36, .39*	Do.
4569-2	.....	68,000	36.0	34.0	.32, .40*	Do.
4578	.....	66,000	30.0	30.7	.28, .32*	Do.
4579	.....	68,000	36.5	37.1	.40*, .33	Do.
4583	.....	63,000	32.5	37.1	.28, .37*	Do.
4589	.....	65,000	35.0	40.3	.40*, .30	Do.
4600	.....	65,500	39.0	40.3	.43*, .35	Do.
4605	.....	65,000	37.0	40.3	.41*, .33	Do.
4609	.....	65,500	41.0	46.2	.44*, .38	Do.
4613	.....	67,500	39.0	37.1	.34, .44*	Do.
4619	.....	66,000	34.0	34.0	.31, .37*	Do.
4623	.....	67,000	38.5	40.3	.34, .43*	Do.
4632	.....	67,000	41.0	46.2	.34, .48*	Do.
4655	.....	65,000	33.5	37.1	.43*, .24	Do.
4659	.....	64,500	41.0	37.1	.43*, .39	Do.
4670	.....	66,000	37.5	37.1	.33, .42*	Do.
4674	.....	66,500	33.0	37.1	.38*, .28	Do.
4711	.....	67,000	40.5	37.1	.46*, .35	Do.
4717	.....	66,500	39.5	40.3	.33, .46*	Do.
4722	.....	68,500	36.5	37.1	.31, .42*	Do.
4725	.....	66,500	35.5	34.0	.38*, .33	Do.
4736	.....	67,500	36.0	37.1	.41*, .31	Do.
4740	.....	66,000	39.0	37.1	.41*, .37	Do.
4746	.....	62,500	35.0	30.7	.31, .39*	Do.
4763	.....	69,500	34.0	34.0	.38*, .30	Do.
4770	.....	71,500	23.5	24.0	.26*, .21	Do.
4774	.....	60,500	30.0	34.0	.25, .35*	Do.
4778	.....	63,000	40.3	37.1	.44*, .37	Do.

5, 6, 10, AND 12 INCH DUMMY BANDS.

1472	.....	65,000	19.5	20.5	.20*, .19	Lavender and light yellow.
1422-2	.....	67,000	25.0	30.7	.26*, .24	Uniform light yellow.
1448	.....	65,500	16.0	20.5	.14, .18*	Do.
1462	.....	66,500	17.5	23.9	.15, .20*	Do.
1487	.....	66,000	20.5	20.5	.20, .21*	Light yellow.
1497	.....	66,000	13.2	16.9	.12, .15*	Lavender and light yellow.
1511	.....	65,500	23.5	23.9	.22, .25*	Light yellow.
1535	.....	59,000	8.5	13.2	.10*, .07	Do.
1521	.....	63,000	18.0	23.9	.20*, .16	Do.
1529	.....	66,000	16.0	16.9	.17*, .15	Do.
1546	.....	67,000	15.0	20.5	.17*, .13	Do.
1554	.....	46,000	3.5	9.5	.01, .06*	Lavender and lemon yellow spots.
1560	.....	52,000	14.5	20.5	.12, .17*	Light yellow.
1568	.....	55,500	15.0	16.9	.15, .15	Lavender.
1602	.....	53,000	5.0	5.7	.04, .06*	Lavender and light yellow.
1630	.....	50,500	3.0	1.8	.02, .04*	Lavender and lemon yellow spots.
1635	.....	59,000	6.0	5.7	.08*, .04	Lavender and light yellow.
1643	.....	30,200	2.0	4.4	0., .04*	Lemon yellow.
1661	.....	58,500	10.0	13.2	.11*, .09	Lavender and light yellow.
1681	.....	62,500	9.0	13.2	.08, .10*	Do.
1697	.....	42,500	2.5	5.7	0., .05*	Lemon yellow.
1714	.....	61,500	13.5	16.9	.11, .16*	Lavender.
1731	.....	58,500	16.0	20.5	.17*, .15	Do.
1737	.....	36,000	1.5	1.8	0., .03*	Lemon yellow.
1743	.....	56,000	8.0	9.5	.06, .10*	Lavender; columnar structure.
1697-2	.....	24,000	2.5	5.7	.04*, .01	Lavender and lemon yellow.
1737-2	.....	33,000	3.5	4.4	0., .07*	Do.
1643-2	.....	28,000	2.5	2.0	0., .05*	Do.
1768	.....	62,000	11.5	16.9	.10, .13*	Lavender and light yellow.
1774	.....	64,000	14.5	16.9	.14, .15*	Do.
1781	.....	63,500	18.0	20.5	.19*, .17	Light yellow.

From Watertown Arsenal—Continued.

5, 6, 10, AND 12-INCH DUMMY BANDS—Continued.

Marks.	Approximate elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Pounds.	*Pounds.*	*Per ct.*	*Per ct.*	" "	
1789	.....	64,500	14.5	20.5	.16*, .13	Light yellow; columnar structure.
1797	.....	59,000	12.5	16.9	.14*, .11	Light yellow.
1805	.....	60,500	12.0	13.2	.14*, .10	Do.
1811	.....	61,000	9.0	13.2	.10*, .08	Do.
1817	.....	60,500	9.5	13.2	.10*, .09*	Do.
1823	.....	59,500	19.0	16.9	.13, .15*	Lavender.
1829	.....	63,500	9.0	13.2	.10*, .08	Lavender and light yellow.
1835	.....	60,500	11.0	16.9	.13*, .09	Do.
1841	.....	58,000	8.0	13.2	.09*, .07	Do.
1847	.....	49,500	3.0	1.8	.05*, .01	Lemon yellow.
1853	.....	60,000	12.5	16.9	.10, .15*	Light yellow.
1863	.....	56,500	17.0	20.5	.19*, .15	Lavender.
1871	.....	56,000	16.0	20.5	.14, .18*	Lavender and light yellow.
1877	.....	63,500	21.0	23.9	.22*, .20	Light yellow.
1883	.....	63,500	28.0	30.7	.31*, .25	Do.
1900	.....	62,000	18.0	20.5	.21*, .15	Lemon yellow and lavender.
1906	.....	61,000	12.0	20.5	.14*, .10	Dark lavender.
1912	.....	61,500	19.5	20.5	.19*, .20*	Lavender and light yellow.
1922	.....	63,500	11.0	16.9	.12*, .10	Light yellow.
1933	.....	60,500	12.0	20.5	.10, .14*	Do.
1941	.....	61,000	12.5	13.2	.12, .13*	Lavender.
1951	.....	74,500	14.5	20.5	.13, .16*	Uniform light yellow.
1955	.....	35,000	2.0	1.8	.03*, .01	Lemon yellow.
1966	.....	63,000	5.5	9.5	.06*, .05	Lavender.
1974	.....	52,200	3.5	9.5	.04*, .03	Lavender and lemon yellow.
1980	.....	60,500	8.0	13.2	.07, .09*	Do.
1986	.....	38,500	2.0	1.8	.03*, .01	Lemon yellow.
1992	.....	60,500	15.0	20.5	.13, .17*	Lavender.
1998	.....	50,500	3.5	9.5	.03, .04*	Lavender and lemon yellow.
2007	.....	44,500	2.5	5.7	.02, .03*	Lemon yellow.
2015	.....	58,500	19.5	27.4	.18, .21*	Light yellow.
2016	.....	39,500	2.0	1.8	0., .04*	Lemon yellow.
2022	.....	60,500	15.0	20.5	.16*, .04	Lavender yellow.
2028	.....	62,000	15.5	20.5	.18*, .13	Light yellow.
2034	.....	62,300	10.0	18.5	.09, .11*	Do.
2045	.....	61,000	8.0	13.2	.09*, .07	Do.
2051	.....	63,000	9.5	13.2	.08, .11*	Do.
1955-2	.....	49,500	3.5	9.5	.03, .04*	Lemon yellow and lavender.
2007-2	.....	48,000	3.5	9.5	.04*, .03	Do.
2074	.....	59,500	14.5	20.5	.14*, .15*	Lavender.
2126	.....	57,000	39.5	40.3	.45*, .34	Silky; light yellow.
2062	.....	60,500	22.0	27.4	.23*, .21	Lavender.
2068	.....	60,000	18.5	20.5	.20*, .17	Do.
2128	.....	55,500	21.5	27.4	.24*, .19	Light yellow.
2134	.....	60,500	26.0	30.7	.26*, .26	Do.
1986	.....	36,000	2.5	1.8	.05*, 0.	Lemon yellow.
2016	.....	35,500	0.	0.	.....	Lemon yellow; blow hole.
2159	.....	63,500	20.0	23.9	.23*, .17	Lavender and light yellow.
2529	.....	63,500	17.5	24.0	.14, .21*	Do.
2538	.....	64,500	11.5	16.9	.14*, .09	Do.
2559	.....	65,500	13.5	16.9	.14*, .13	Do.
3519	.....	61,500	28.0	30.7	.30*, .26	Light yellow.
3452	.....	47,000	2.5	5.7	0. .05*	Light yellow; lemon yellow spots.
3488	.....	60,500	13.0	16.9	.14*, .12	Light yellow.
3502	.....	61,500	26.0	30.7	.23, .29*	Do.
3542A	.....	63,000	9.5	13.2	.08, .11*	Do.

BRONZE INGOTS.

4188	.....	65,000	37.5	34.0	.39*, .36	Light yellow; fine silky.
4189	.....	60,500	50.5	54.6	.51*, .50*	Do.
4199	27,000	68,000	47.5	40.3	.52*, .43	Do.
4219	35,000	73,000	7.5	9.6	.08, .07*	Light yellow; fine granular.
4220	28,500	63,500	18.0	20.5	.18*, .18*	Dark lavender; fine granular.
4236	36,000±	85,500	20.0	24.0	.20*, .20*	Light yellow; fine granular.
4240	32,500	81,000	17.5	20.5	.17*, .18*	Do.
4241	32,000	83,500	16.0	16.9	.17*, .15*	Do.

MISCELLANEOUS.

Marks.	Description.	Approximate elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections,	Appearance of fracture.
		Pounds.	*Pounds.*	*Per ct.*	*Per ct.*	" "	
1422	12" dummy projectiles		36,500	4.5	9.5	.02, .07*	Lavender and lemon yellow.
1438	.....do		65,000	23.0	27.4	.20*, .20	Uniform light yellow.
3042	15-pounder projectiles		32,500	5.5	9.5	.07*, .04	Lavender.
2251	5" and 6" rammers		54,000	36.5	34.0	.26*, .37*	Light yellow.
2254	5" and 6" rammers and sponges		53,500	38.0	34.0	.33, .43*	Do.
2282	5" and 6" sponges		63,500	22.5	27.4	.26*, .19	Do.
2350-3	5" and 6" rammers and sponges		17,500	2.0	1.8	0. .04*	Light gray and yellow.
2333-2	.....do		55,500	18.0	23.9	.15, .21*	Lavender and light yellow.
2408	5" and 6" rammers		60,500	23.5	27.4	.23*, .24	Do.
2457	5" and 6" rammers and sponges		64,500	17.0	20.5	.16, .18*	Brownish yellow.
2571	5" and 6" rammers		67,000	16.0	16.9	.16*, .16	Light and dark yellow.
2613	6" sponges		60,500	15.5	20.5	.18*, .13	Lavender and light yellow.
2493	5" and 6" rammers		61,500	15.0	16.9	.16*, .14	Do.
2712	5", 6", 10", and 12" rammers and sponges		68,500	14.5	16.9	.13, .16*	Light yellow.
2728	6", 10", and 12" rammers and sponges		65,000	12.0	16.9	.13*, .11	Lavender and light yellow.
2759	5", 6", 10", and 12" rammers and sponges		63,000	22.5	27.4	.23*, .22	Light yellow.
2786	.....do		61,000	10.5	20.5	.12*, .09	Lavender and light yellow.
2854	6" sponges, etc		61,500	5.0	5.7	.03, .07*	Light yellow; columnar.
3320	5" and 6" sponges		51,000	3.0	9.5	.04*, .02	Light yellow.
3428	4".7 and 5" sponges and rammers	23,000	57,500	9.5	16.9	.07, .12*	Dark yellow.
3469	5" sponges and rammers		39,000	2.0	5.7	.03*, .01	Light yellow.
3469-2	.....do		63,500	10.5	13.2	.11*, .10	Do.
	Manganese bronze, July 3		76,500	31.0	34.0	.28, .34*	Uniform light yellow.
PO9	Manganese bronze		80,000	20.0	23.9	.22*, .18	Light yellow.
2284	Material on PO135		59,000	37.0	54.6	.47*, .27	Silky; light yellow.
2285	.....do		59,000	39.0	62.2	.49*, .29	Do.
2286	.....do		64,000	29.0	49.1	.18, .40*	Do.
PO807	Bronze rod	52,250	84,680	.....	59.5	.....	Silky; light yellow. Broke in jaws.
PO807	.....do		84,680	20.5	55.9	.30*, .11	Silky; light yellow.
PO742-2	Tobin bronze plate	88,030	89,320	11.0	22.6	.15*, .07	Light yellow; oblique.
PO742	Tobin bronze	41,000	62,000	21.0	37.1	.30*, .12	Light yellow; fine silky.
PO820	.....do		67,000	26.0	5.0	.29*, .23	Light yellow; silky.
PO1004-1	.....do	51,000	71,500	25.0	43.3	.21, .29*	Do.
PO1004-2	.....do	44,000	64,000	31.5	58.0	.30, .33*	Do.
PO1004-3	.....do	55,000	76,000	16.5	51.0	.09, .24*	Do.
PO1004-4	.....do	44,000	65,000	31.0	58.0	.32*, .30	Do.
PO820-2	.....do	52,960	66,800	24.0	38.3	.28*, .20	Light yellow; oblique.
PO457-1	Manganese bronze, Oct. 6	38,000	82,500	20.5	23.9	.20*, .21*	Light yellow.

MISCELLANEOUS—Continued.

Marks.	Description.	Approximate elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
		Pounds.	*Pounds.*	*Per ct.*	*Per ct.*	" "	
PO457-2	Manganese bronze, Oct. 20	31,800	75,900	30.0	34.0	.27, .33*	Light yellow.
3584A	5" and 6" sponges		47,000	4.5	5.7	.06*, .03	Lavender and lemon yellow.
3601A	do		47,000	6.0	27.4	.04, .08*	Do.
3614A	6" sponges		47,000	3.0	9.6	.04*, .02	Do.
3672A	6", 10", and 12" sponges		57,000	5.0	13.2	.07*, .03	Do.
3687A	6" and 10" rammers and sponges		40,500	1.5	5.7	.03*, 0.	Do.
3719BK	6" sponges		66,500	11.0	20.5	.09, .13*	Brownish yellow.
3729BK	do		61,500	11.5	20.5	.10, .13*	Do.
3751BK	do		68,500	7.5	13.2	.09*, .06	Light yellow; irregular.
3765BK	do		62,500	15.5	24.0	.17*, .14	Light yellow.
3784BK	do		63,000	21.0	27.4	.20, .22*	Light yellow; irregular.
3687A2	6" and 10" sponges and rammers		51,500	4.0	9.6	.02, .06*	Lavender; lemon-yellow spots.
3803BK	6" sponges		63,500	9.5	16.9	.05, .14*	Light yellow; irregular.
PO1228-1	Tobin bronze		57,000	40.0	46.2	.33, .47*	Light yellow; fine silky.
PO1228-2	do		57,500	41.0	51.9	.51*, .31	Do.
PO742-5	do	27,000	57,000	41.0	62.2	.50*, .32	Do.
PO742-6	do	36,360	59,030	45.5	38.3	.42*, .49*	Light yellow; oblique.
PO742-7	do	35,480	57,100	46.0	42.7	.59*, .43	Do.
PO742-8	do	35,700	57.210	46.5	43.8	.41*, .52*	Do.
	do		61,000	13.5	37.1	.09, .18*	Light yellow; fine silky.
PO1914	do		54,000	51.0	57.2	.45, .57*	Do.

COMPRESSION TEST OF TOBIN BRONZE.

Specimen from recoil buffer No. 10, 6″ barbette carriage.
Hammered hot.

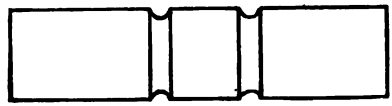
No. 1183.

Length of specimen over all, 5″.
Diameter, 1″.
Sectional area, .7854 square inch.
Gauged length, 4″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
785.4	1,000	0.	0.	Initial load.
3,927	5,000	.0011	0.	
7,854	10,000	.0026	0.	
11,781	15,000	.0038	0.	
15,708	20,000	.0050	0.	
19,635	25,000	.0066	0.	
20,420	26,000	.0069	.....	
21,206	27,000	.0071	.....	
21,991	28,000	.0074	.....	
22,777	29,000	.0078	.....	
23,562	30,000	.0081	.0001	
24,347	31,000	.0084	.....	
25,133	32,000	.0087	.....	Elastic limit.
25,918	33,000	.0092	.....	
26,764	34,000	.0097	.....	
27,489	35,000	.0104	.0008	
28,274	36,000	.0111	.....	
29,060	37,000	.0124	.....	
29,845	38,000	.0147	.....	
30,631	39,000	.0184	.....	
31,416	40,000	.0220	.0102	
46,700	59,460	.....	.....	Ultimate strength.

Failed by triple flexure.

Shearing Test of Rod Copper.



Diameter of rod, $\frac{1}{2}''$.
Diameter at root of groove, $\frac{3}{8}''$.
Total shearing area (two planes), .22 square inch.

Sample.	Shearing strength.	
	Total.	Per square inch.
	Pounds.	*Pounds.*
1	6,520	29,600
2	6,530	29,700

CHEMICAL ANALYSES, CAST AND PIG IRON AND STEEL.

CHEMICAL ANALYSES OF PIG IRONS.

Description	Total carbon.	Manganese.	Silicon.	Sulphur.	Phosphorus.
P. O. No. 11, car 9748	.....	.60	3.370	.033	.557
P. O. No. 11, car 13160	.....	.68	3.290	.034	.560
P. O. No. 11, car 6873	.....	.65	3.200	.034	.525
P. O. No. 11, car 651	.....	.70	3.240	.034	.518
Bessemer, P. O. No. 210, car 94833	.....	.50	2.32	.025	.025
Bessemer P. O No. 210, car 22294	.....	.50	2.35	.028	.035
Hinckle, P. O. No. 315, car 12448	.....	.67	2.04	.027	.254
Hinckle, P. O. No. 315, car 23309	.....	.66	2.06	.029	.310
Hinckle	4.245	.66	.....	.....	.....
Muirkirk	3.310	.96	.....	.....	.....
Car 1442	3.750	.....	.....	.....	.....
P. O. No. 463, car 9084	.....	.38	2.570	.015	.030
P. O. No. 463, car 45507	.....	.38	2.420	.017	.031
Charcoal, P. O. No. 925, car 35650	.....	1.20	2.38	.048	.175
P. O. No. 687, car 9011	.....	.58	1.97	.015	.023
P. O. No. 687, car 48534	.....	.60	2.16	.034	.025
P. O. No. 984, car 8783	.....	1.10	2.49	.020	.320
P. O. No. 925, car 14732	.....	1.20	3.16	.085	.300
P. O. No. 984, car 2199	.....	1.50	2.11	.032	.350
P. O. No. 687, car 63552	.....	.56	1.97	.029	.030
Rogers, Brown & Co., car 20538	.....	.90	2.020	.054	.500
Powell & Colne, car 80018	.....	.55	2.090	.037	.018
Car 95432	.....	.62	1.50	029	.020
Car 44199	4.226	.68	1.50	.027	.020
Car 46287	.....	.68	1.50	.027	.020
Car 61510	.....	.68	1.69	.027	.018
Car 90600	.....	.67	1.65	.028	.020
Car 36742	.....	.38	1.92	.037	.018
Car 48218	.....	.44	2.32	.023	.018
Car 91415	.....	.66	1.67	.023	.020
Car 66310	.....	.66	1.72	.027	.018
Car 49604	.....	.68	2.60	.015	.027
Bessemer, car 63552	.....	.56	2.060	.030	.032
P. O. No. 1062, car 9505	.....	2.10	3.160	.025	.254
Car 40360	.....	1.25	2.450	.024	.310
P. O. No. 1369, car 13986	.....	.84	3.170	.015	.029
P. O. No. 1369, car 56849	.....	.90	3.000	.015	.021
P. O. No. 1369, car 101905	.....	.88	2.910	.015	.025
P. O. No. 1369, car 22492	.....	1.00	3.070	.015	.025
P. O. No. 1369, car 106080	.....	1.000	2.960	.015	.025
P. O. No. 1360, car 48712	.....	.900	2.930	.018	.026
P. O. No. 1360, car 19174	.....	.960	2.820	.019	.025
P. O. No. 1369, car 22225	.....	.960	3.170	.019	.026
P. O. No. 1369, car 68746	.....	.960	2.750	.016	.025
P. O. No. 1369, car 91149	.....	.980	2.870	.015	.023
P. O. No. 1369, car 26214	.....	.960	3.140	.015	.025
P. O. No. 984, car 6242	.....	.54	1.75	.050	.357
P. O. No. 984, car 5322	.....	.65	2.39	.050	.458
P. O. No. 687, car 4101	.....	.56	2.05	.016	.025

CHEMICAL ANALYSES OF CAST-IRON FROM ARSENAL FOUNDRY.

Description.	Carbon.			Manganese.	Silicon.	Sulphur.	Phosphorus.
	Total.	Graphitic.	Combined.				
Marks 771-2	3.054	2.217	0.837	0.50	1.034	.....	.....
Marks 772-1	2.481	2.072	.409	.52	.963	.....	.....
Marks 775	3.058	2.099	.959	.52	1.151	.....	.....
Marks 776-1 and 2	3.000	2.200	.800	.55	1.128	.....	.....
Marks 770	2.536	2.072	.464	.55	.872	.....	.....
Marks 765-1 and 2	2.966	1.908	1.058	.53	1.034	.....	.....
Marks 762	2.961	2.391	.571	.52	1.080	.....	.....
Marks 752-2	2.931	2.107	.824	.45	1.075	.....	.....
Marks 351-2	3.095	2.214	.881	.36	1.081	.....	.....
Marks 459-2	3.001	2.361	.640	.52	1.151	.....	.....
Marks 556-1	3.029	2.301	.728	.56	1.110	.....	.....
Marks 764	2.917	2.730	.184	.52	1.034	.....	.....
Marks 763-1	2.830	2.381	.449	.50	1.128	.....	.....
Marks 476	2.931	2.080	.851	.51	1.080	.....	.....
Marks 844-2	3.078	.....	.....	.60	1.034	.....	.....
Marks 844-1	2.852	.....	.....	.60	1.048	.....	.....
Marks 844-2	3.078	.....	.....	.60	1.034	.....	.....
Marks 863	2.727	.....	.....	.....	.940	.....	.....
12-inch base ring	2.898	.....	.....	.60	.940	.....	.....
Marks 1051-1	.....	.....	.....	.70	1.50	0.034	0.200
Marks 1057-1	.....	.....	.....	.70	.940	.....	.....
12-inch base ring, 168	.....	2.304	.....	.43	1.74	.081	.500
Marks 1301-2	.....	.....	.....	.68	1.410	.075	.129
Marks 1302-2	.....	.....	.....	.68	1.390	.078	.130
12-inch base ring, 175	3.092	2.481	.611	.45	1.410	.050	.300
Marks 1153-1	2.896	2.004	.892	.64	.940	.....	.....
Marks 1153-2	2.661	1.840	.821	.69	.890	.....	.....
Marks 173	3.180	2.448	.732	.39	1.640	.....	.....
Marks 168	2.999	2.279	.720	.41	1.880	.....	.....
Marks 1164-1	2.713	1.827	.886	.....	.940	.098	.....
Marks 1164-2	2.730	2.017	.713	.....	.....	.078	.....
12-inch mortar racer	2.863	1.690	1.173	.330	.446	.138	.228
Marks 1168-1	.....	.....	.....	.720	1.110	.....	.....
Marks 1168-2	.....	.....	.....	.700	1.120	.....	.....
12-inch racer, No. 1	.....	.....	.....	.33	1.210	.....	.....
12-inch racer, No. 2	.....	.....	.....	.33	1.451	.....	.....

CHEMICAL ANALYSES OF SPECIMENS FROM 6-INCH GUN LEVER AXLE.

[For tensile tests see forged steel from arsenal smith shop.]

Description.	Combined carbon.
972 X	.66
972 Y	.60
972 Z	.62
Fractured end	.82
Opposite fractured end	.74

CHEMICAL ANALYSES OF BAYONET STEEL FROM SPRINGFIELD ARMORY.

Description.	Combined carbon.	Manganese.	Silicon.	Sulphur.	Phosphorus.
Helmuth	1.202	.395	.141	.027	.024
Farist	1.350	.542	.085	.031	.018
Illingworth	.975	.387	.138	.032	.019
Midvale	1.093	.270	.188	.025	.019
Carpenter	1.030	.198	.127	.032	.014
B	.932	.430	.005	.038	.018
G	.995	.200	.105	.015	.012
Baldwin	1.009	.419	.028	.030	.016
Carpenter	.880	.335	.127	.030	.014

CHEMICAL ANALYSIS OF STEEL FOR EJECTORS FROM SPRINGFIELD ARMORY.

Description.	Combined carbon.	Manganese.	Silicon.	Sulphur.	Phosphorus.
Ejector steel	.671	.335	.188	.018	.016

CHEMICAL ANALYSIS OF SPECIAL STEEL FROM SPRINGFIELD ARMORY.

Description.	Combined carbon.	Manganese.	Silicon.	Sulphur.	Phosphorus.	Nickel.	Chromium.
Carpenter special	.440	.471	.240	.015	.015	1.378	1.250

CHEMICAL ANALYSES OF SPECIAL STEEL OF HIGH TENSILE STRENGTH.

	Combined carbon.	Manganese.	Silicon.	Chromium.	Nickel.
	.350 .352	.355 .360	.152 .136	1.300 1.342	1.100 1.140

STEEL FOR COMPARISON OF TESTING MACHINES.

TENSILE TESTS OF STEEL SPECIMENS FOR COMPARISON OF TESTING MACHINE AT FRANKFORD ARSENAL.

Diameter of stems, ″.564; sectional area, .25 square inch.
Gauged length, 3″.

Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
Pounds.	*Pounds.*	*Per cent*	*Per cent*	″ ″ ″	
45,200	69,200	31.3	61.5	.19,.54*,.21	Fine silky.
45,600	69,600	32.0	61.5	.20,.54*,.22	Do.
40,200	67,800	32.0	61.5	.20,.54*,.22	Do.
45,520	68,400	31.3	61.5	.21,.53*,.20	Do.
43,200	68,400	31.0	61.5	.20,.53*,.20	Do.

TENSILE TESTS OF SPECIMENS OF CRUCIBLE BARREL STEEL FOR COMPARISON OF TESTING MACHINE AT ROCK ISLAND ARSENAL.

Marks	Diameter.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation in 6 inches.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Inches.	*Sq.in.*	*Lbs.*	*Lbs.*	*P. ct.*	*P. ct.*	″ ″ ″ ″ ″ ″	
C1	1.0092	.80	69,940	120,230	16.3	44.8	.09,.13,.43*,.15, .10, .08	Fine silky.
C3	1.0092	.80	70,310	120,200	17.7	44.8	.10,.20,.42*,.13, .11, .10	Do.
C5	1.0092	.80	70,310	119,840	16.7	44.8	.08,.10,.12, .32*,.28*,.10	Do.
C7	1.0092	.80	70,310	120,490	17.7	44.8	.09,.12,.26, .35*,.14, .10	Do.
C9	1.0092	.80	70,560	120,870	18.2	44.8	.09,.14,.15, .40*,.20, .11	Do.
C11	1.0092	.80	70,820	120,490	18.2	44.8	.10,.12,.32*,.31*,.14, .10	Do.

TENSILE TESTS OF SPECIMENS FOR COMPARISON OF TESTING MACHINE AT WORKS OF THE DRIGGS-SEABURY ORDNANCE CORPORATION, AKRON, OHIO.

Marks.	Kind of metal.	Diameter.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation in 2 inches.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
		Inch.	*Sq.in.*	*Lbs.*	*Lbs.*	*P. ct.*	*P. ct.*	″ ″	
DS3	Steel.....	.500	.196	42,350	48,470	39.5	73.0	.55*,.24	Fine silky; cup-shaped.
DS10	Bronze...	.797	.500	[a]16,400	25,200	10.0	6.8	.07, .13*	Light purple color.
DS11	Cast iron.	1.129	1.000	.....	19,600	.....	.....	.....	Granular; gray.

[a] Approximate.

STEELS, MISCELLANEOUS.

Diameter of stems, ″.505; length, 2″.
Sectional area, .20 square inch.

Brand.	Size of bar.	Treatment.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Inches.		*Pounds.*	*Pounds.*	*Per ct.*	*Per ct.*	″ ″	
Crescent tool steel	$\frac{5}{16}$ square		72,500	139,500	9.5	13.2	.10*, .09*	Fine granular, radiating from punch mark.
Do	do	Annealed	68,000	123,500	8.5	13.2	.06*, .11*	Do.
Park Bros. tool steel	$1\frac{1}{4}$ round		67,000	127,500	10.5	16.9	.09, .12*	Fine granular, radiating from silky spot at circumference.
Do	do	Annealed	57,000	108,000	12.0	16.9	.15*, .10*	Fine granular, radiating from punch mark.
Do	$1\frac{1}{8}$ square		57,000	128,000	10.0	13.2	.07, .13*	Granular; silky center.
Do	do	Annealed	48,000	117,000	9.5	13.2	.01, .10*	Granular.
Blue chip steel	$1\frac{1}{16}$ round		56,500	124,000	12.0	13.2	.12*, .12*	Fine granular, raidating from punch mark.
Do	do	Annealed	69,500	127,000	9.5	13.2	.09*, .10*	Do.
Styrian high speed	$\frac{3}{4}$ square	do	65,000	151,000	10.0	13.2	.12*, .08	Fine granular, radiating from a spot at circumference.
Do	do	do	63,000	149,000	9.5	16.1	.13*, .06	Do.
Crucible tool-steel bar		Forged and annealed in charcoal.	43,000	113,000	11.5	20.5	.15*, .08	Granular; silky center.
Do		Hardened in water; drawn at blue.	[a] 141,500	141,500	1.0	(b)	.01, .01	Granular.
Do		Hardened in water; drawn at straw.	[a] 109,000	109,000	0.5	(b)	.01*, .00	Do.
Styrian steel		Hardened in water; drawn at blue.		94,000				Broke in thread. Fine granular.

[a] Approximate.

[b] Inappreciable.

SHEET STEEL.

Specimens furnished by the Hon. N. B. Scott, Committee on Public Buildings and Grounds, United States Senate.

TENSILE TESTS.

Mark on specimen.	Dimensions in inches.		Sectional area.	Elastic limit.		Tensile strength.		Elongation in .5 inch.		Area at fracture.	Contraction of area.
	Width.	Thickness.		Total.	Per square inch.	Total.	Per square inch.				
			Sq. in.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*In.*	*Pr. ct.*	*In. In. Sq. in.*	*Per ct.*
End 1 [a]	.247	.017	.0042	255	60,710	280	66,670	.63	6.0	.240×.0155=.0037	11.9
End 2 [a]	.249	.016	.0040	230	57,500	295	73,750	.05	10.0	.240×.015 =.0036	10.0

[a] Appearance of fracture, granular.

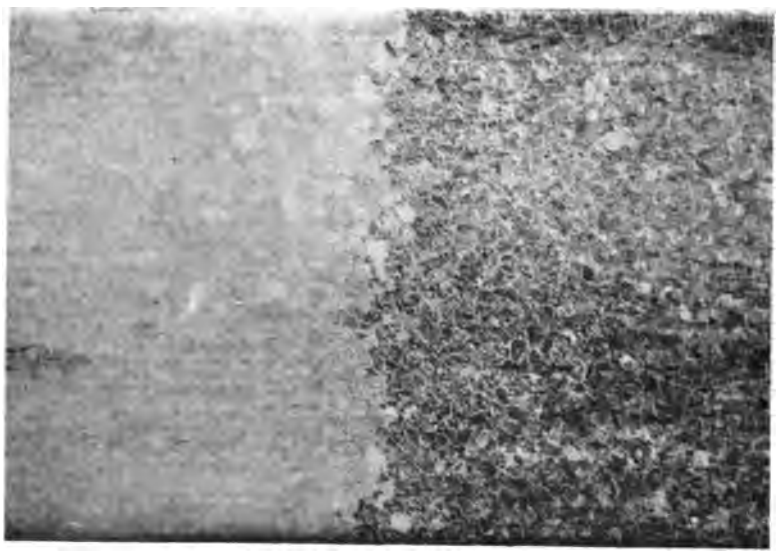
BENDING TEST.

Specimens bent as prescribed in section 15, page 23, of Form No. 434, for flange steel, without fracture.

TENSILE TESTS OF FLANGE STEEL PLATES.

FROM THE PARK WORKS OF THE CRUCIBLE STEEL COMPANY, PITTSBURG, PA.

Marks.	Dimensions.		Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation in 2 inches.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Width.	Thickness.							
	Inches.	*Inches.*	*Sq. ins.*	*Pounds.*	*Pounds.*	*Per ct.*	*Per ct.*	" "	
1....	.998	.127	.127	65,350	75,590	26.0	45.7	.14, .38*	Silky.
2....	1.003	.136	.136	56,470	71,250	29.0	49.3	.20, .38*	Do.
1....	.995	.137	.136	58,100	72,060	24.5	46.3	.37*, .12	Fine silky.
2....	1.000	.137	.137	55,500	70,070	25.0	53.3	.11, .39*	Do.
3....	.996	.136	.135	27,400	50,810	38.5	62.2	.24, .53*	Do.
4....	1.006	.137	.138	53,600	66,300	28.5	47.1	.21, .36*	Do.
5....	1.005	.136	.137	24,100	48,540	45.0	69.3	.31, .59*	Do.
6....	.995	.137	.136	32,900	64,710	26.5	51.5	.39*, .14	Do.
7....	1.001	.138	.138	54,300	67,030	25.5	52.9	.22*, .29*	Do.
8....	1.000	.136	.136	62,500	72,060	20.5	44.1	.33*, .08	Do.



MICRO-PHOTOGRAPH OF SPECIMEN FROM GUN LEVER AXLE,
SHOWING LIGHT AND DARK COLORED METAL.
MAGNIFICATION, 2 DIAMETERS.

CAMPBELL ART CO.
ELIZABETH, N. J.

TENSILE TEST OF SPECIMEN FROM GUN LEVER AXLE.

Specimen was taken out of the keyway of a journal which showed different colored metal in its length.

Diameter of stem of specimen	inch..	.480
Sectional area of stem	square inch..	.18
Elastic limit, total	pounds..	6,200
Elastic limit per square inch	do....	34,440
Tensile strength, total	do....	14,620
Tensile strength per square inch	do....	81,220
Elongation in 4", ".31	per cent..	7.8
Diameter at fracture	inch..	.42
Area	square inch..	.1385
Contraction of area	per cent..	23.1
Elongation of inch sections		".03, ".05, ".17*, ".06
Appearance of fracture		medium granular

The junction of the light and dark colored metal of this specimen was located at the middle of its length. Fracture occurred about ".4 away from this junction in the light colored metal.

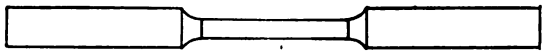
A. P. DETONATING FUSE.

Tensile test of specimen taken from a rough-turned steel forging.

Diameter.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation in 5 inches.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
Inch. .798	*Sq. in.* .50	*Pounds.* 44,600	*Pounds.* 114,200	*Per ct.* 8.6	*Per ct.* 11.6	" " " " " .13*, .10, .09, .06, .05	Granular.

Anchor Bolts for Gun Carriages.

Tension specimen.



Bending specimen.

Description.	Diameter.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.	Bending test.
	Inches.	*Sq. inch.*	*Pounds.*	*Pounds.*	*Per cent.*	*Per cent.*	" " "		
Anchor bolt for 6-inch R. F. gun, from U. S. Engineer Corps, Norfolk, Va.	1.129	1.00	28,400	57,200	30.7	53.4	.20, .21, .25 .25, .35, .67* .30, .23	Silky; small light-colored spots.	Bent cold and closed down upon itself without fracture.

TENSION TEST OF SPECIMEN FROM END OF AN AMMUNITION HOIST SHAFT RECEIVED FROM U. S. ENGINEER'S OFFICE, BOSTON.

Diameter.	Sectional area.	Elastic limit.		Tensile strength.		Elongation.		Diameter at fracture.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
		Total.	Per square inch.	Total.	Per square inch.						
In.	*Sq. in.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*In.*	*P. ct.*	*In.*	*P. ct.*	"	
.505	.20	11,800	59,000	13,600	68,000	.34	34.0	.32	59.8	.34	Fine silky.

TENSION TESTS OF SPECIMENS FROM SABER GUARDS RECEIVED FROM SPRINGFIELD ARMORY.

Dimensions.		Sectional area.	Elastic limit.		Tensile strength.		Elongation in 1 inch.		Area at fracture.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
Width.	Thickness.		Total.	Per square inch.	Total.	Per square inch.						
Inch.	*Inch.*	*Sq. inch.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Inch.*	*Per cent.*	*In. in. sq. in.*	*Per cent.*	"	
.250	.100	.025	1,210	48,400	1,510	60,400	.26	26.0	.17×.07=.012	52.0	.24*	Silky.
.250	.100	.025	1,050	42,000	1,460	58,400	.26	26.0	.16×.06=.010	60.0	.26*	Do.
.250	.100	.025	1,080	43,200	1,470	58,800	.25	25.0	.16×.06=.010	60.0	.25*	Do.
.250	.100	.025	1,020	40,800	1,470	58,800	.32	32.0	.15×.05=.008	68.0	.32*	Do.

TENSILE TESTS OF STEEL FOR INTRENCHING SHOVELS, FROM WYOMING SHOVEL WORKS.

Specimen.	Dimensions.		Sectional area.	Elastic limit.		Tensile strength.		Elongation in 2 inches.		Area at fracture.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Width.	Thickness.		Total.	Per square inch.	Total.	Per square inch.						
	Inch.	*Inch.*	*Sq. in.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Inch.*	*Per. ct.*	*In. in. sq. in.*	*Per cent.*	" "	
Lengthwise	1.00	.072	.072	6,100	84,720	7,760	107,780	.38	19.0	.86×.05=.043	40.3	.11, .27*	Fine silky.
Crosswise	1.00	.072	.072	6,200	86,110	7,790	108,190	.41	20.5	.85×.05=.0425	41.0	.10, .31*	Do.

CHEMICAL ANALYSIS.

Combined carbon.	Manganese.	Silicon.	Sulphur.	Phosphorus.
.660	.294	.100	.040	.020

TENSILE TEST OF SPECIMEN FROM REAR SIGHT BRACKET BUSHING, 3-INCH FIELD GUN, MODEL 1902.

Specimen turned down from a $1\frac{3}{8}$" bar.
Received from Frankford Arsenal.

Diameter.	Sectional area.	Elastic limit.		Tensile strength.		Elongation		Diameter at fracture.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
		Total.	Per square inch.	Total.	Per square inch.						
Inch .505	*Sq. inch.* .20	*Pounds.* 8,100	*Pounds.* 40,500	*Pounds.* 17,600	*Pounds.* 88,000	*Inch.* .46	*Per cent.* 23.0	*Inch.* .39	*Per cent.* 40.3	" " .30, *.16	Silky.

TENSILE TESTS OF STEEL WIRE FOR SAFETY LANYARD HOOKS.

Diameter of wire, ″.125.
Sectional area, .0123 square inch.

Marks.	Description.	Tensile strength.		Appearance of fracture.
		Total.	Per square inch.	
		Pounds.	*Pounds.*	
1	Cold rolled	1,360	110,570	Fine silky.
1	Cold rolled, annealed	810	65,850	Do.
2	Cold rolled	1,320	107,320	Do.
2	Cold rolled, annealed	780	63,410	Do.
3	Cold rolled	1,360	110,570	Do.
3	Cold rolled, annealed	820	66,667	Do.

TENSILE TESTS OF THE HOOKS.

Made from ″.125 diameter cold-rolled wire, annealed.

Hook No.	Tensile strength.	Manner of failure.
	Pounds.	
1	142	Straightened hook.
2	152	Straightened eye.
3	148	Straightened hook.
4	150	Do.
5	138	Do.
6	164	Straightened hook and eye.
7	140	Straightened hook.
8	146	Do.
9	164	Straightened hook and eye.
10	171	Do.
11	178	Straightened hook.
12	164	Do.

TENSILE TEST OF A FIRST-CLASS BUOY SHACKLE FOR THE UNITED STATES LIGHT-HOUSE ESTABLISHMENT, TOMPKINSVILLE, N. Y.

Diameter of iron of shackle, 2″.
Tensile strength, 230,100 pounds.
Fractured pin of shackle.

CORDAGE: MANILA, LINEN, AND WIRE ROPE.

TENSILE TESTS OF CORDAGE FOR THE UNITED STATES LIGHT-HOUSE ESTABLISHMENT, THIRD DISTRICT, TOMPKINSVILLE, N. Y.

Samples prepared with eye-splices at the ends.
Length between splices, 5 to 6 feet.

HEMP ROPE.

Circumference.		Actual diameter.	Number of strands.	Yarns per strand.	Lay 1 turn in.	Tensile strength.	Parted.
Nominal.	Actual.						
Inches.	*Inches.*	*Inches.*			*Inches.*	*Pounds.*	
2½	3.00	.96	3	15	2.80	3,800	1 strand at the splice.
3	3.20	1.02	4	19	2.70	5,140	1 strand 3″ from the splice.
3½	3.87	1.26	4	26	3.16	6,100	1 strand at the splice.

MANILA ROPE.

Splices immersed in water before testing.

Circumference.		Actual diameter.	Number of strands.	Yarns per strand.	Lay 1 turn in.	Tensile strength.	Parted.
Nominal.	Actual.						
Inches.	*Inches.*	*Inches.*			*Inches*	*Pounds.*	
6 threads	.99	.29	3	2	.90	620	1 strand 18″ from the splice.
9 threads	1.22	.37	3	3	1.02	1,250	1 strand 20″ from the splice.
9 threads	1.30	.42	3	3	1.25	1,260	1 strand 14″ from the splice.
15 threads	1.55	.49	3	5	1.42	1,860	1 strand 4″ from the splice.
15 threads	1.64	.52	3	5	1.60	1,620	1 strand 24″ from the splice.
21 threads	1.80	.57	3	7	1.90	2,040	1 strand 12″ from the splice.
1	1.10	.34	3	3	1.02	820	1 strand 15″ from the splice.
1½	1.64	.56	3	6	2.04	2,550	1 strand 10″ from the splice.
2	2.53	.84	4	8	2.72	4,800	2 strands 26″ from the splice.
2½	2.85	.92	4	11	3.16	5,790	1 strand 3″ from the splice.
3	3.52	1.10	4	16	3.54	8,050	1 strand at the splice.
3½	4.30	1.38	4	23	4.18	11,800	Do.
4	4.60	1.52	4	30	4.24	14,700	Do.
4½	5.02	1.66	4	35	4.40	17,050	Do.
5	5.32	1.80	4	40	4.70	18,100	Do.
5½	6.02	2.00	4	50	5.40	18,750	1 strand 3″ from the splice.
6	7.10	2.33	4	62	5.80	25,300	1 strand at the splice.
7	8.02	2.63	4	90	6.60	29,400	Do.

The 4-strand specimens each have a core.

MANILA ROPE.

Samples prepared for testing with eye-splices at the ends.

Circumference.		Number of strands.	Yarns per strand.	Tensile strength.	Parted.
Nominal.	Actual.				
Inches.	*Inches.*			*Pounds.*	
18 thread....	.68	3	6	1,910	1 strand at the splice.
4.....	4.45	4	28	12,420	Do.
4½.....	5.25	4	35	18,950	Do.
5.....	5.50	4	42	22,600	Do.
5½.....	6.60	4	53	23,500	Do.
6.....	7.25	4	62	30,800	Do.
7[a].....	8.60	4	89	39,300	Do.

[a] Coil No. 1.

HEMP ROPE.

2½.....	2.72	4	12	4,080	1 strand 5″ from splice.
3.....	3.33	4	17	5,960	1 strand at the splice.
3½.....	3.93	4	23	7,850	Do.

MANILA ROPE. COIL NO. 1.

4.....	4.55	4	29	14,900	1 strand at the splice.
5½.....	6.12	4	50	23,400	2 strands in the splice.
7.....	7.85	4	86	38,500	1 strand in the splice.

MANILA ROPE.

4.....	4.37	4	30	11,500	1 strand at the splice.
5½.....	5.95	4	51	17,100	Do.
6.....	7.10	4	68	29,400	Do.
7.....	7.70	4	88	29,100	Do.

TENSILE TESTS OF BRAIDED LANYARD.

Diameter of samples, ″.18.
Ends secured around grooved pins.

Sample No.	Tensile strength.	Parted.
1	231	6″ from pin.
2	250	15″ from pin.
3	249	2″ from pin.

TENSILE TEST OF SOLID BRAIDED LINEN LINE FROM SILVER LAKE COMPANY.

Marks, "No. 5 linen."
Diameter, ″.18.
Tensile strength, 210 pounds.

TENSILE TESTS OF PLOW STEEL DURABLE ROPE.

FIRST SPECIMEN.

Diameter, ″.80.
Rope composed of five strands of steel wire with hemp covering and core. The strands measured ″.30 diameter over the hemp serving. The wire strand, uncovered, measured ″.17 diameter. It was composed of 19 wires ranging in diameter from ″.029 to ″.036 each.
Tensile strength, 14,100 pounds.
Parted three strands at end of splice.

SECOND SPECIMEN.

Diameter, 1″.13.
Rope composed of five strands of steel wire with hemp covering and core. The strands measured ″.43 diameter over the hemp serving. The wire strand, uncovered, measured ″.25 diameter. It was composed of 19 wires ranging in diameter from ″.052 to ″.059 each.
Tensile strength, 31,800 pounds.
Parted three strands at end of splice.

TENSILE TESTS OF ROPES WITH ONE END OF EACH SECURED BY CLAMPS.

Two clamps to each rope.

FIRST SPECIMEN.

Diameter, ″.80.
First test. Maximum resistance, 9,400 pounds. Rope drew through clamps.
Second test. Maximum resistance, 4,200 pounds. Rope drew through clamps.

SECOND SPECIMEN.

Diameter, 1″.13.
First test. Maximum resistance, 12,600 pounds.
Second test. Maximum resistance, 13,900 pounds. After attaining the maximum resistance and commencing to pull the rope through the clamps, there was an immediate drop in the holding power of the clamps. After this the rope continued to draw through the clamps with a pull of about 4,000 pounds. The hemp service yielded under the clamps and was stripped from the wires of the strands.

TENSILE TESTS OF 2¼-INCH STEEL WIRE ROPE.

Specimens received from the U. S. Naval Constructor, New York Navy-Yard.

FIRST SPECIMEN.

The ends of the sample of rope were secured by means of conical pins in steel sockets.

On the first trial of this rope one end drew from the socket under a load of 132,000 pounds tension. Two wires were broken, but no real injury done the rope.

The end which drew out was remade in its socket and the rope subjected to a second load of tension. On this occasion the opposite end drew out of its socket under a load of tension of 300,000 pounds.

Refastening this end, the rope was again subjected to a load of tension. At 321,000 pounds the rope in part drew out of one socket and in part fractured the wires of which it was composed. Fifty wires were broken. The fractures were silky and the metal well drawn down at the place of rupture.

Test discontinued.

The strength of a rope is gauged by the method of fastening, and while only a part of the total number of wires of this rope were fractured, it is believed that substantially the available strength of the sample was shown in the third test. Wire ropes in general fracture in detail at the fastening, and such tendency is not lessened as the size increases.

SECOND SPECIMEN.

Ends of rope secured in conical sockets by means of tapering pins.

Ultimate resistance, 330,000 pounds.

One strand parted 9 to 12 inches from face of south socket; another strand parted 9 inches from the face of the north socket; the other strands pulled out of the north socket, each rupturing a few wires in the north socket.

THIRD SPECIMEN.

Ends of rope secured in conical sockets by means of tapering pins.

Ultimate resistance, 311,100 pounds.

The wires of the rope fractured at a distance of 6 to 12 inches from the face of one of the sockets. There were 36 wires unbroken, which drew out of the socket.

HELICAL SPRINGS.

COMPRESSION TESTS OF ONE COUNTER RECOIL SPRING (INNER AND OUTER) FOR DRIGGS-SEABURY 15-POUNDER MASKING MOUNT.

Specifications require inner spring to be compressed to height of 8″.5, outer to 9″.50 for sixty hours, and after this to sustain at least 1,000 pounds when compressed to 14 and 15 inches, respectively.

Spring was assembled and loaded as above, after which it exerted a sustaining power of 1,245 pounds at 14 and 15 inches height, respectively.

COMPRESSION TESTS OF THREE SETS OF RECOIL SPRINGS FOR 15-POUNDER CARRIAGES.

DIMENSIONS.

Description.	Free height.	Exterior diameter.	Diameter of wire.	Distance between coils.
	Inches.	*Inches.*	*Inch.*	*Inch.*
Outer spring No. 1	19.30	3.80	0.56	0.60
Inner spring No. 1	16.40	2.37	.37	.35
Outer spring No. 2	19.27	3.85	.50	.60
Inner spring No. 2	19.02	2.80	.37	.48
Outer spring No. 3	20.00	3.85	.49	.60
Inner spring No. 3	18.77	2.80	.37	.48

TESTS OF SPRINGS.

SET NO. 1.

Outer spring:		
Free height	inches..	19.30
Load at 15″, going down	pounds..	1,079
Load at 10″	do....	2,350
Load at 15″, coming back	do....	887
Final free height	inches..	19.20
Inner spring:		
Free height	do....	16.40
Load at 14″, going down	pounds..	398
Load at 9″	do....	1,225
Load at 14″, coming back	do....	348
Final free height	inches..	16.36

SET NO. 2.

Outer spring:		
Free height	inches..	19.27
Load at 15″, going down	pounds..	538
Load at 10″	do....	1,180
Load at 15″, coming back	do....	492
Final free height	inches..	19.23
Inner spring:		
Free height	do....	19.02
Load at 14″, going down	pounds..	468
Load at 9″	do....	1,022
Load at 14″, coming back	do....	437
Final free height	inches..	19.00

SET NO. 3.

Outer spring:		
Free height	inches..	20.00
Load at 15″, going down	pounds..	636
Load at 10″	do....	1,296
Load at 15″, coming back	do....	572
Final free height	inches..	19.97
Inner spring:		
Free height	do....	18.87
Load at 14″, going down	pounds..	417
Load at 9″	do....	981
Load at 14″, coming back	do....	412
Final free height	inches..	18.75

COMPRESSION TESTS OF THREE SETS OF HELICAL SPRINGS FOR 15-POUNDER DRIGGS-SEABURY MOUNTS.

DIMENSIONS.

Description.	Free height.	Exterior diameter.	Diameter of wire.	Distance between coils.	Weight.
	Inches.	*Inches.*	*Inch.*	*Inch.*	*Lbs. Ozs.*
Outer spring No. 1	20.00	3.81	.56	.60	12 8
Inner spring No. 1	16.80	2.35	.37	.35	4 6.5
Outer spring No. 2	20.30	3.80	.56	.60	12 5.5
Inner spring No. 2	16.85	2.34	.37	.35	4 6.75
Outer spring No. 3	20.00	3.81	.56	.60	12 5.5
Inner spring No. 3	16.96	2.34	.37	.35	4 7.25

TESTS OF SPRINGS.

SET No. 1.

Outer spring:		
Load at height of 15", going down	pounds..	1,240
Solid height	inches..	9.92
Load at height of 15", coming back	pounds..	1,051
Inner spring:		
Load at height of 14", going down	do....	473
Solid height	inches..	8.69
Load at height of 14", coming back	pounds..	454

SET No. 2.

Outer spring:		
Load at height of 15", going down	pounds..	1,245
Solid height	inches..	9.88
Load at height of 15", coming back	pounds..	938
Inner spring:		
Load at height of 14", going down	do....	442
Solid height	inches..	8.78
Load at height of 14", coming back	pounds..	439

SET No. 3.

Outer spring:		
Load at height of 15", going down	pounds..	1,204
Solid height	inches..	9.83
Load at height of 15", coming back	pounds..	955
Inner spring:		
Load at height of 14", going down	do....	498
Solid height	inches..	8.78
Load at height of 14", coming back	pounds..	445

COMPRESSION TESTS OF HELICAL COUNTER RECOIL SPRINGS FOR 7-INCH MORTAR CARRIAGES, MODEL 1895.

DIMENSIONS.

	Number of spring.		
	1.	2.	3.
Free height.....inches..	19.12	19.00	18.85
Exterior diameter.....do...	5.00	5.00	5.01
Diameter of wire.....inch..	.68	.68	.68
Distance between coils.....do...	.78	.78	.78
Weight.....pounds..	18.97	19.06	18.97

TESTS OF SPRINGS.

	Number of spring.		
	1.	2.	3.
Height under 1,000 pounds load, going down.....inches..	15.80	15.94	15.65
Solid height.....do...	9.46	9.40	9.27
Height under 1,000 pounds load, coming back.....do...	15.70	15.63	15.48

COMPRESSION TESTS OF HELICAL BUFFER SPRINGS FOR 10-INCH DISAPPEARING CARRIAGES, L. F. MODEL 1901.

DIMENSIONS.

Free height	inches..	6.30
Exterior diameter	do...	2.75
Diameter of wire	inch..	.50
Distance between coils	do...	.30
Weight	pounds..	3.25

TESTS OF SPRINGS.

Free height.	Load at 5".5.	Load at 4".5.	Load at 5".5.	Final free height
Inches.	*Pounds.*	*Pounds.*	*Pounds.*	*Inches.*
6.30	892	1,927	678	6.10
6.33	902	1,958	744	6.23
6.35	1,014	2,142	856	6.28
6.34	994	2,050	762	6.20
6.34	994	2,106	805	6.25
6.32	907	1,899	714	6.24

COMPRESSION TEST OF RECOIL SPRING FOF 6-POUNDER DRIGGS-SEABURY MOUNT.

DIMENSIONS.

Free height	inches..	13.47
Exterior diameter	do...	2.60
Diameter of wire	inch..	.44
Distance between coils	do...	.32
Weight	pounds..	4.97

TEST OF SPRING.

Free height	inches..	13.47
Load at height of 12"	pounds..	392
Height when solid	inches..	7.93
Load at solid height	pounds..	1,750
Load at height of 12"	do....	322
Final free height	inches..	13.33

TESTS ON THE FRICTIONAL RESISTANCE OF 6-INCH PROJECTILES IN RIFLED TUBE SECTIONS, AND TENSILE SHEARING, AND HARDNESS TESTS OF THE BAND METAL.

TESTS ON THE FRICTIONAL RESISTANCE OF 6-INCH PROJECTILES IN RIFLED TUBE SECTIONS, AND TENSILE, SHEARING, AND HARDNESS TESTS OF THE BAND METAL.

Description of the Tests.

Preliminary tests were made on samples of bronze cast at the Watertown Arsenal, representing material which might be used for bearings. Dry sand, green sand, and chilled castings were represented in the state after casting, and also annealed and hammered. These bronzes did not give promise of being suitable for use in bands, and their examination was therefore discontinued at the end of the tensile tests.

The several grades of metal used as bands were as follows:

Copper-zinc alloy of copper 82, zinc 18.
Copper-nickel alloy of copper 90, nickel 10.
Copper-nickel alloy of copper 92.5, nickel 7.5.
Copper-nickel alloy of copper 95, nickel 5.
Copper-nickel alloy of copper 97.5, nickel 2.5.
Regular copper band metal.

Tensile, shearing, and hardness tests were made on each of these several alloys. This metal was obtained from the Scovill Manufacturing Company, Waterbury, Conn., excepting the regular copper band metal. The rolled strips, ½ inch thick by 1¾ inches wide, furnished by the Scovill Company, were in two grades, soft and hard.

Four short, rifled sections representing the rifled bores of 6-inch guns, each about 12 inches long, were received from Watervliet Arsenal, within which the frictional tests were made. At the entering end the lands were turned off taperingly over a length of about ″.95.

The projectiles were furnished with bands of standard section for 6-inch guns. The several bands were forced through the tube sections in the order in which they are entered in the details of the tests. No lubricant was used. The total time occupied in the frictional resistance tests is given. In the early stages of each experiment the movement of the projectile was very slow, to permit observing the changes in resistance which accompanied the taking of the form of the rifling by the band. After this had been accomplished the speed during the remainder of the test was more rapid. About one-half of the total time was occupied in observing the early changes in resistance.

One grade of metal was used in each of the tube sections until each of the four sections had been used. There was a return then to the first section, and the remaining tests of the series were made on this one.

In the tensile, shearing, and hardness tests, the several grades used in the bands were each tested in the state received and after having been hammered cold.

Discussion of the Results.

The tests of bronzes cast at Watertown Arsenal showed the effect of the chill in raising the tensile strength. The difference between dry sand and green sand castings was not marked. Annealing did not

cause a marked effect. Hammering cold raised the tensile strength of each grade of metal, and each treatment. Hot hammering raised the strength of the dry and green sand castings in a marked degree, but did not have so much effect on the chilled castings.

Referring to the tests of the strips purchased of the Scovill Company, the tensile strength of the soft metal is exceeded by the hard grade, the difference amounting to from 12,000 to 17,000 pounds per square inch. While the contraction of area is large in each case, the elongation of the hard metal is less than that of the soft. The hammered strips showed higher tensile strength than the unhammered ones, both in the hard and the soft metal. A certain part of the stretch of the metal is developed by the hammering, and that portion necessarily disappears from the tensile test.

In the results of the shearing tests, corresponding differences do not appear. The several tests are nearly the same for metal of the same composition, irrespective of treatment.

From the results of the shearing tests it would be inferred that the manner in which the metal was treated would not have a pronounced effect on the resistance of the band in taking the rifling. The brass band gave the highest tensile strength and also the highest shearing resistance, the nickel alloys giving results which, in the main, appear successively lower as the per cent of nickel grows less, while the copper band gave the lowest results of all. The hardness determinations follow in the same order.

The frictional resistance tests began with band metal of copper 92.5, nickel 7.5, using the soft grade in the first instance. The early behavior showed the successive stages of resistance reaching a first maximum, then falling, reaching a second maximum, again rising to a third maximum, the highest resistance encountered, and thereafter slowly falling, and during the remainder of the test continuing with great fluctuations in resistance.

The successive maxima represent the times when the several ridges of metal of the band reached the rifled section of the tube. After shearing one of these zones the resistance fell until the next one reached the critical part of the rifling, and so on until the band was fully engaged in the rifling. In each instance some of the metal of the band was detached and remained behind the projectile near the entrance end, or was sheared off and did not enter the tube section. There were cases in which an entire ring of band metal was sheared off and remained outside of the tube. The percentage of band metal which went through the tube section varied, inasmuch as the weight of the detached portions was not the same in each case.

Two projectiles were forced through each tube section, one with the soft grade and one with the hard grade of metal in the bands, until the several sections were exhausted. Generally the second projectile encountered more resistance in the bore than the first. The surface of the rifling was slightly roughened as successive projectiles passed through.

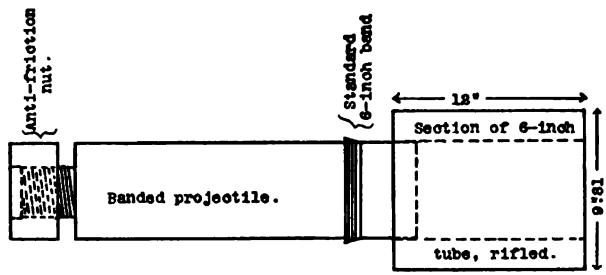
The supply of unused tube sections having become exhausted, there was a return to section No. 1. Projectiles with hard and soft grades of metal containing copper 97.5, nickel 2.5, were now used. The results showed higher resistance along the bore than had been found in the earlier tests.

A projectile with a band of regular copper metal was the fifth to be forced through this section. Its resistance was less than the Cu 97.5, Ni 2.5 bands, but more than the bands of Cu 92.5, Ni 7.5, the latter two being the first to be forced through this section. An additional test was made using a band having copper 92.5, nickel 7.5, to compare the resistance now furnished by the tube with the first test that was made on the same metal. The highest resistance of the series was displayed by this projectile. From this it will be seen that the highest and the lowest resistances were displayed by band metal of the same composition and of the same grade.

Observations on the expansion of the exterior diameter of tube section No. 1 showed a movement of ″.0037 at a distance of 2″.4 from the entering end, this being over the band at its place of maximum resistance in the bore.

Supplementary tests were made in tube section No. 2, in order to furnish further data upon the increased frictional resistance as successive projectiles are used. The results in section No. 2 confirmed those which had been obtained with section No. 1.

FRICTIONAL RESISTANCE OF BANDED PROJECTILES IN THE BORE OF SECTIONS OF 6-INCH RIFLED TUBES.



Lands of the tube sections bored out conically for a length of .95 inch.

Projectiles banded with metal in two grades—soft and hard, respectively. Bands made with standard dimensions for 6-inch projectiles.

RIFLED SECTION OF TUBE NO. 1.

Length of section, 12″; exterior diameter, 9″.81.
Forcing cone, of lands, ″.95 long.
Metal of band: Copper, 92.5; nickel, 7.5; soft.

Frictional resistance.	Travel of projectile.	Remarks.
Pounds.	*Inches.*	
1,000	0.	Initial load.
12,000	.01−	
20,000	.01	
22,000	.01+	
25,000	.02	
30,000	.03	
35,000	.07	
17,000	.16	
20,000	.17	
25,000	.17+	
35,000	.17+	
40,000	.17	
45,000	.18	
50,000	.18+	
55,000	.19	
60,000	.20	
65,000	.20	
70,000	.20	
75,000	.20+	
80,000	.20+	
85,000	.21	
90,000	.21+	
95,000	.22	
98,000	.27	
90,000	.45	
84,000	.55	
95,000	.62	
100,000	.67	
108,000	1.18	Maximum resistance.
90,000	2.12	
75,000	2.81	
61,000	4.29	
60,000	5.86	
54,000	7.71	
51,000	9.50	
56,000	11.10	
40,000	12.10	

SAME TUBE SECTION AS ABOVE, No. 1.

Metal of band: Copper, 92.5; nickel, 7.5; hard.

Frictional resistance.	Travel of projectile.	Remarks.
Pounds.	*Inches.*	
1,000	0.	Initial load.
10,000	.01	
18,000	.02	
25,000	.06	
29,600	.08	
13,000	.15	
25,000	.16	
30,000	.16+	
40,000	.17	
50,000	.17+	
60,000	.17+	
70,000	.18	
80,000	.19	
90,000	.22	
91,000	.24	
80,000	.35	
60,000	.46	
70,000	.56	
80,000	.60	
100,000	.70	
110,000	.74	
120,000	.83	
128,400	1.02	Maximum resistance.
110,000	1.27	
90,000	1.97	
85,000	2.90	
70,000	3.62	
62,000	5.05	
50,000	8.00	
45,000	9.70	
48,000	11.00	

One-fourth ounce of the metal of the band sheared off and remained in the forcing cone of the lands.

Rifled Section of Tube No. 2.

Metal of band: Copper, 82; zinc, 18; soft.

Frictional resistance.	Travel of projectile.	Remarks.
Pounds.	*Inches.*	
1,000	0.	Initial load.
3,000	.01	
4,000	.05	
6,000	.06	
10,000	.08	
20,000	.08	
25,000	.09	
30,000	.10	
32,000	.12	
35,000	.13	
40,000	.14	
41,500	.15	
37,000	.17	
19,000	.25	
25,000	.26	
40,000	.26+	
45,000	.26+	
55,000	.27	
65,000	.28	
75,000	.29	
81,000	.34+	
72,000	.37	
61,000	.41	
70,000	.45	
80,000	.45+	
90,000	.46	
100,000	.46	
120,000	.47	
140,000	.48	
156,000	.54	Maximum resistance.
140,000	.58	
120,000	.72	
112,000	1.04	
105,000	1.86	
95,000	2.50	
80,000	4.25	
70,000	7.80	
66,000	9.50	
65,000	11.25	

A ring of band metal weighing about ½ ounce was sheared off before taking the rifling.

Duration of test, 30 minutes.

SAME TUBE SECTION AS ABOVE, No. 2.

Metal of band: Copper, 82; zinc, 18; hard.

Frictional resistance.	Travel of projectile.	Remarks.
Pounds.	*Inches.*	
1,000	0.	Initial load.
10,000	0.	
15,000	.01	
20,000	.02	
25,000	.05	
29,000	.10	
10,000	.14	
12,000	.17	
20,000	.19	
40,000	.20	
60,000	.23	
25,000	.34	
50,000	.38	
80,000	.39	
100,000	.39+	
140,000	.40	
147,000	.48	Maximum resistance.
100,000	.54	
90,000	.74	
125,000	1.00	
100,000	2.20	
93,000	3.75	
90,000	6.40	
83,000	9.50	
73,000	11.30	

A ring of the band metal weighing about ½ ounce was sheared off before taking the rifling.

Duration of test, 25 minutes.

RIFLED SECTION OF TUBE No. 3.

Metal of band: Copper, 90; nickel, 10; hard.

Frictional resistance.	Travel of projectile.	Remarks.
Pounds.	*Inches.*	
1,000	0.	Initial load.
10,000	.01	
15,000	.02	
20,000	.04	
25,000	.06	
29,000	.10	
18,000	.13	
25,000	.17	
35,000	.17+	
45,000	.18	
54,000	.19	
60,000	.21	
70,000	.25	
90,000	.36	
110,000	.39	
130,000	.39+	
150,000	.43	
155,000	.47	Maximum resistance.
146,000	.51	
125,000	.73	
138,000	1.22	
110,000	2.20	
90,000	3.70	
81,000	5.30	
73,000	7.20	
72,000	10.00	
82,000	11.30	

Duration of test, 25 minutes.

SAME TUBE SECTION AS ABOVE, No. 3.

Metal of band: Copper, 90; nickel, 10; soft.

Frictional resistance.	Travel of projectile.	Remarks.
Pounds.	*Inches.*	
1,000	0.	Initial load.
10,000	.01	
18,000	.09	
30,000	.10	
40,000	.12	
50,000	.15	
57,000	.18	
42,000	.24	
70,000	.27	
100,000	.29	
130,000	.32	
150,000	.37	
184,000	.82	Maximum resistance.
183,000	.95	
150,000	1.35	
103,000	2.25	
98,000	4.00	
91,000	6.50	
80,000	8 00	
77,000	9.50	
78,000	10.80	

About ½ ounce of band metal was sheared off and lodged in chamfered section.

Duration of test, 15 minutes.

RIFLED SECTION OF TUBE No. 4.

Metal of band: Copper, 95; nickel, 5; hard.

Frictional resistance.	Travel of projectile.	Remarks.
Pounds.	*Inches.*	
1,000	0.	Initial load.
3,000	.02	
10,000	.07	
20,000	.10	
22,000	.19	
40,000	.21	
50,000	.23	
61,000	.28	
100,000	.40	
150,000	.44	
159,000	.50	Maximum resistance.
154,000	.55	
113,000	1.02	
90,000	3.40	
73,000	7.50	
72,000	11.00	

About ¾ ounce of band metal sheared off and lodged in chamfered section of tube.

Duration of test, 15 minutes.

SAME TUBE SECTION AS ABOVE, No. 4.

Metal of band: Copper, 95; nickel, 5; soft.

Frictional resistance.	Travel of projectile.	Remarks.
Pounds.	*Inches.*	
1,000	0.	Initial load.
10,000	.01	
20,000	.05	
28,000	.10	
14,000	.15	
20,000	.16	
30,000	.17	
50,000	.20	
58,000	.27	
50,000	.31	
80,000	.35	
100,000	.37	
130,000	.42	
133,000	.50	Maximum resistance.
100,000	.81	
95,000	2.00	
86,000	6.30	
84,000	9.50	
83,000	11.00	

Duration of test, 12 minutes.

RIFLED SECTION OF TUBE No. 1.

Metal of band: Copper, 97.5; nickel, 2.5; hard.

Frictional resistance.	Travel of projectile.	Remarks.
Pounds.	*Inches.*	
1,000	0.	Initial load.
10,000	.01	
15,000	.02	
24,000	.09	
11,000	.13	
30,000	.15	
50,000	.17	
64,000	.22	
52,000	.29	
80,000	.32	
100,000	.34	
147,000	.42	
142,000	.53	
120,000	.80	
140,000	1.14	
163,000	1.55	
165,000	2.80	Maximum resistance.
140,000	4.95	
126,000	7.30	
113,000	10.60	
100,000	11.30	

About ¼ ounce of band metal sheared off and lodged in chamfered section of tube.

Duration of test, 16 minutes.

SAME TUBE SECTION AS ABOVE, No. 1.

Metal of band: Copper, 97.5; nickel, 2.5; soft.

Frictional resistance.	Travel of projectile.	Remarks.
Pounds.	*Inches.*	
1,000	0.	Initial load.
10,000	.01	
21,000	.07	
11,000	.14	
50,000	.19	
53,000	.24	
38,000	.30	
100,000	.34	
131,000	.41	
129,000	.56	
111,000	.84	
161,000	2.40	Maximum resistance.
153,000	3.30	
142,000	5.70	
130,000	8.20	
120,000	10.40	

About ½ ounce of band metal sheared off and lodged in chamfered section of tube.

Duration of test, 15 minutes.

SAME TUBE SECTION AS ABOVE, No. 1.

Metal of band: Regular copper.

Frictional resistance.	Travel of projectile.	Remarks.
Pounds.	*Inches.*	
1,000	0.	Initial load.
5,000	.01	
10,000	.02	
14,000	.05	
8,000	.10	
10,000	.11	
30,000	.13	
57,000	.21	
60,000	.30	
100,000	.33	
118,000	.43	
80,000	.62	
116,000	1.40	
124,000	2.40	Maximum resistance.
100,000	4.25	
98,000	7.20	
81,000	10.20	

A continuous ring of band metal sheared off at the chamfered section, the weight of which was 1 ounce.

Duration of test, 16 minutes.

SAME TUBE SECTION AS ABOVE, NO. 1.

Metal of band: Regular copper (second band of this metal).

Frictional resistance.	Travel of projectile.	Remarks.
Pounds.	*Inches.*	
1,000	0.	Initial load.
5,000	.01	
131,000	.43	
120,000	1.00	
130,000	1.50	
134,000	2.40	Maximum resistance.
120,000	3.27	
123,000	5.30	
115,000	7.90	
100,000	10.50	
80,000	11.00	

A continuous ring of band metal was sheared off at the chamfered section, the weight of which was 1¼ ounces.

Observations were made on the expansion of the exterior diameter of the tube section, at a place 2″.4 from the breech end. The expansion in diameter was found to be ″.0037 at the time the travel of the piston was 2″.4, the resistance now being at its maximum, 134,000 pounds.

SAME TUBE SECTION AS ABOVE, NO. 1.

Metal of band: Copper, 92.5; nickel, 7.5; soft.

Frictional resistance.	Travel of projectile.	Remarks.
Pounds.	*Inches.*	
1,000	0.	Initial load.
10,000	.01	
18,000	.07	
11,000	.08	
62,000	.19	
148,000	.36	
195,000	1.28	
188,000	1.70	
210,000	2.40	Maximum resistance.
200,000	3.00	
180,000	4.20	
160,000	6.00	
110,000	8.80	

Duration of test, 14 minutes.

METAL FOR EXPERIMENTAL BANDS OF PROJECTILES.

TENSILE TESTS.

Diameter of stems, ".357; sectional area, .10 square inch; gauged length, 1".

Composition.			Description.	Approximate elastic limit per square inch.	Tensile strength per square inch.	Elongation in 1 inch.	Contraction of area.	Appearance of fractures.
Copper.	Nickel.	Zinc.						
				Pounds.	*Pounds.*	*Per ct.*	*Per ct.*	
82	.....	18	Soft	12,200	40,200	71	80	Fine silky; light yellow.
82	.....	18	Soft, hammered	45,000	46,700	38	77	Do.
82	.....	18	Hard	55,000	57,000	26	65	Do.
82	.....	18	Hard, hammered	58,200	58,600	28	69	Do.
90	10	.....	Soft	20,500	37,800	62	80	Fine silky; dark red copper colored.
90	10	.....	Soft, hammered	51,200	51,200	24	72	Fine silky; dark red copper colored; minute hole at center
90	10	.....	Hard	51,400	51,400	24	65	Fine silky; dark red copper colored.
90	10	.....	Hard, hammered	54,600	54,600	20	69	Do.
92.5	7.5	.....	Soft	14,000	35,900	63	77	Fine silky; red copper colored.
92.5	7.5	.....	Soft, hammered	42,600	42,600	37	72	Do.
92.5	7.5	.....	Hard	48,100	48,100	28	69	Do.
92.5	7.5	.....	Hard, hammered	50,200	50,200	22	62	Do
95	5	.....	Soft	18,000	34,200	56	69	Fine silky; red copper colored; opened cracks along stem.
95	5	.....	Soft, hammered	52,000	52,000	25	75	Fine silky; red copper colored.
95	5	.....	Hard	46,400	46,400	26	75	Do.
95	5	.....	Hard, hammered	51,500	51,500	23	65	Do.
97.5	2.5	.....	Soft	17,000	33,000	56	65	Fine silky; red copper colored; opened cracks along stem.
97.5	2.5	.....	Soft, hammered	43,800	43,800	25	77	Fine silky; red copper colored.
97.5	2.5	.....	Hard	43,200	43,200	29	72	Do.
97.5	2.5	.....	Hard, hammered	46,200	46,200	21	58	Do.
100	.....	.....	Regular band metal.	15,400	31,600	59	72	Silky.
100	.....	.....	Regular band metal, hammered.	41,000	41,000	47	69	Do.

Shearing Tests.

Specimens ½″ diameter, with V-shaped grooves at shearing planes. Diameter at root of grooves, ″.375; shearing area, .22 square inch.

Composition.			Description.	Shearing strength.	
Copper.	Nickel	Zinc.		Total.	Per square inch.
				Pounds.	*Pounds.*
82	.....	18	Soft	8,400	38,180
82	.....	18	Soft, hammered	8,520	38,730
82	.....	18	Hard	8,460	38,450
82	.....	18	Hard, hammered	8,850	40,230
90	10	.....	Soft	8,360	38,000
90	10	.....	Soft, hammered	8,360	38,000
90	10	.....	Hard	8,450	38,410
90	10	.....	Hard, hammered	8,440	38,360
92.5	7.5	.....	Soft	7,550	34,320
92.5	7.5	.....	Soft, hammered	8,200	37,270
92.5	7.5	.....	Hard	8,250	37,500
92.5	7.5	.....	Hard, hammered	8,250	37,500
95	5	.....	Soft	7,600	34,550
95	5	.....	Soft, hammered	8,200	37,270
95	5	.....	Hard	8,100	36,820
95	5	.....	Hard, hammered	7,800	35,450
97.5	2.5	.....	Soft	7,200	32,730
97.5	2.5	.....	Soft, hammered	8,150	37,050
97.5	2.5	.....	Hard	7,300	33,180
97.5	2.5	.....	Hard, hammered	7,200	32,730
100	.....	.....	Regular band metal	6,500	29,550
100	.....	.....	Regular band metal, hammered	5,900	26,820

Hardness.

[As determined with indenting tool.]

Composition.			Description.	Direction of cut.	Hardness.
Copper.	Nickel.	Zinc.			
82	.....	18	Soft	Lengthwise	3.57
82	.....	18	.....do	Crosswise	3.56
82	.....	18	Hard	Lengthwise	3.55
82	.....	18	.....do	Crosswise	8.93
90	10	.....	Soft	Lengthwise	3.46
90	10	.....	.....do	Crosswise	3.48
90	10	.....	Hard	Lengthwise	8.26
90	10	.....	.....do	Crosswise	7.74
92.5	7.5	.....	Soft	Lengthwise	Below 3.33
92.5	7.5	.....	.....do	Crosswise	Do.
92.5	7.5	.....	Hard	Lengthwise	7.30
92.5	7.5	.....	.....do	Crosswise	7.10
97.5	2.5	.....	Soft	Lengthwise	Below 3.33
97.5	2.5	.....	Hard	.....do	6.92
97.5	2.5	.....	.....do	Crosswise	6.46
100	.....	.....	.....	Lengthwise	Below 3.33

SUPPLEMENTARY TESTS.

Additional tests on frictional resistance of banded projectiles in rifled bores of sections of 6-inch tubes.

RIFLED SECTION OF TUBE No. 2.

Metal of band: Copper, 92.5; nickel, 7.5; soft.

Frictional resistance.	Travel of projectile.	Remarks.
Pounds.	*Inches.*	
1,000	0.	Initial load.
10,000	.01	
20,000	.03	
30,000	.09	
32,000	.11	
21,000	.13	
18,000	.17	
30,000	.19	
40,000	.20	
70,000	.22	
80,000	.24	
83,000	.32	
100,000	.39	
120,000	.40	
150,000	.46	
160,000	.50	
167,000	.68	Maximum resistance.
155,000	.70	
150,000	.90	
140,000	1.32	
130,000	2.00	
120,000	2.80	
118,000	4.00	
112,000	6.20	
100,000	9.10	
90,000	10.90	

A few small pieces of band metal were sheared off and remained in the breech end of the tube.

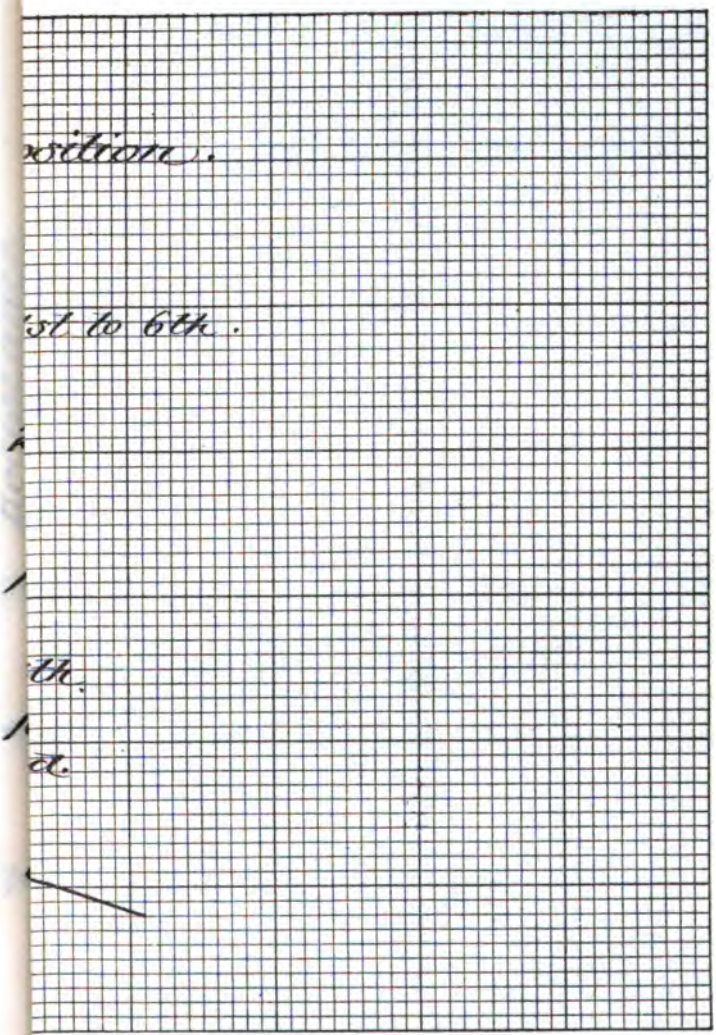
Duration of test, 20 minutes.

SAME TUBE SECTION AS ABOVE, No. 2.

Metal of band: Copper, 82; zinc, 18; soft.

Frictional resistance.	Travel of projectile.	Remarks.
Pounds.	*Inches.*	
1,000	0.	Initial load.
10,000	.03	
20,000	.08	
13,000	.14	
30,000	.17	
50,000	.19	
70,000	.21	
85,000	.26	
69,000	.37	
100,000	.39	
130,000	.40	
170,000	.41	
200,000	.49	Maximum resistance.
150,000	.70	
162,000	1.09	
170,000	1.30	
172,000	1.65	
160,000	2.45	
143,000	3.80	
130,000	5.10	
120,000	7.00	
110,000	10.00	

A continuous ring of band metal was sheared off the rear end of the band, the weight of which was $\frac{3}{4}$ ounce.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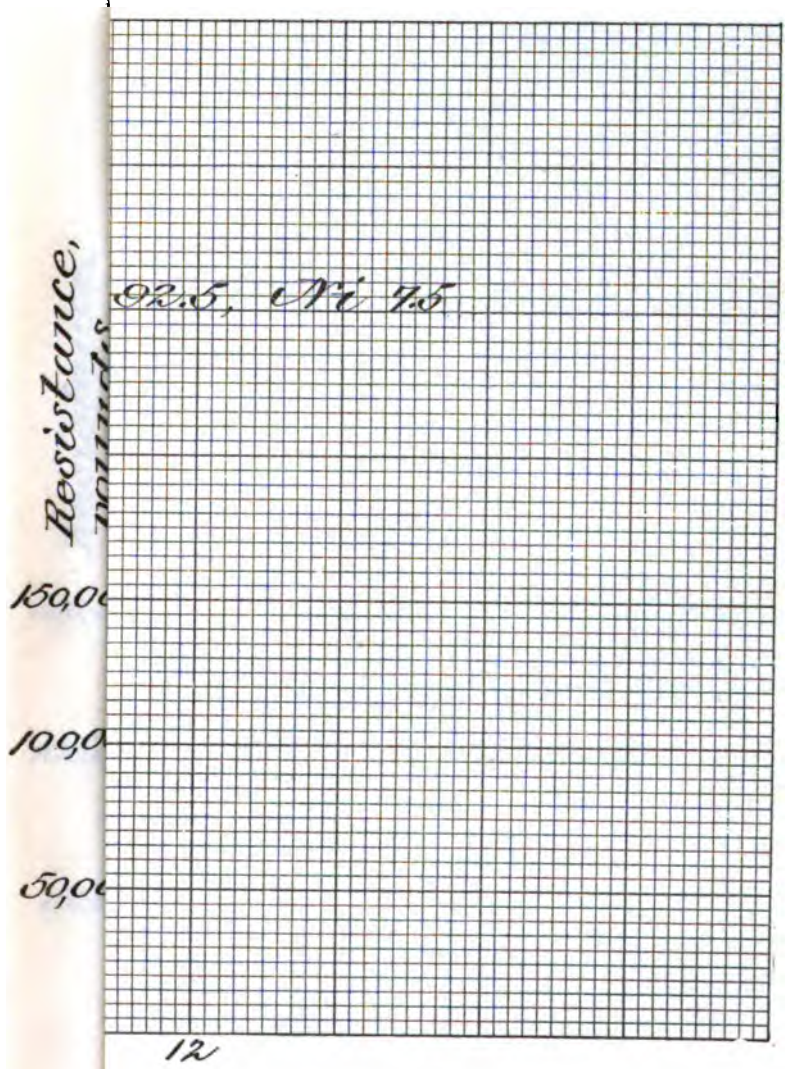
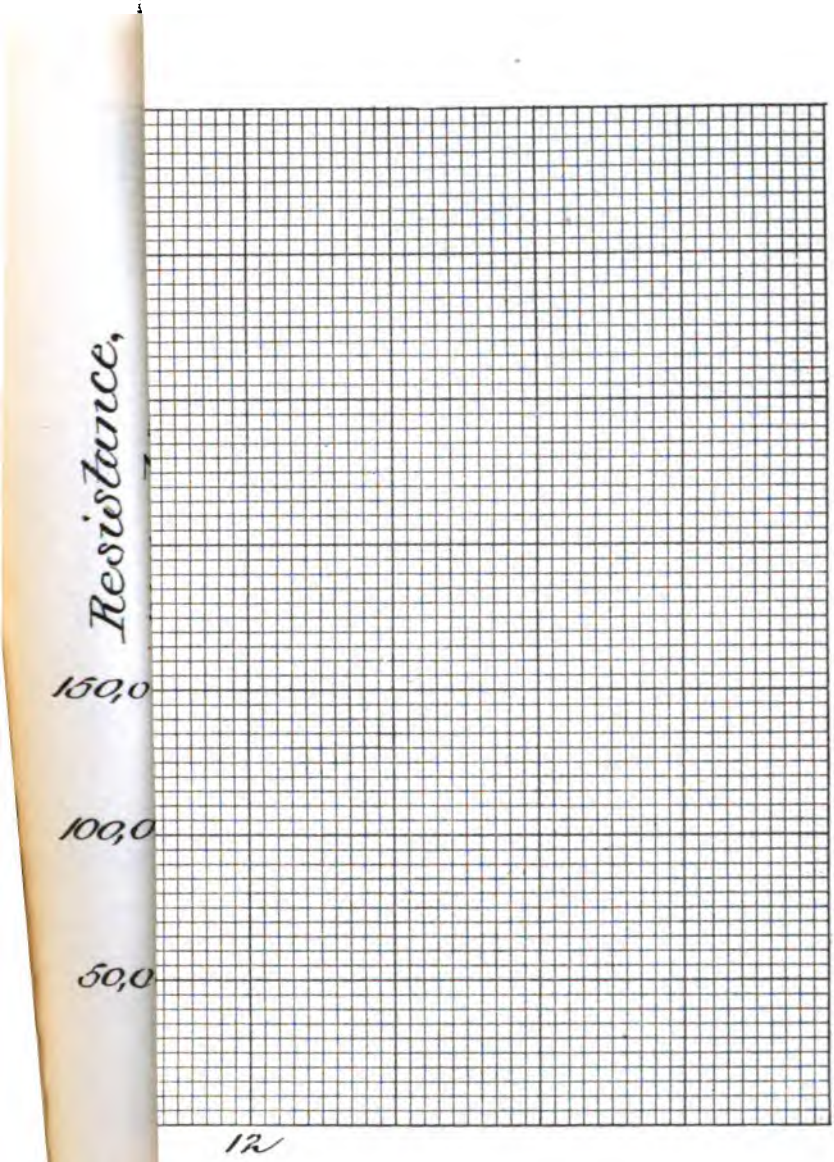
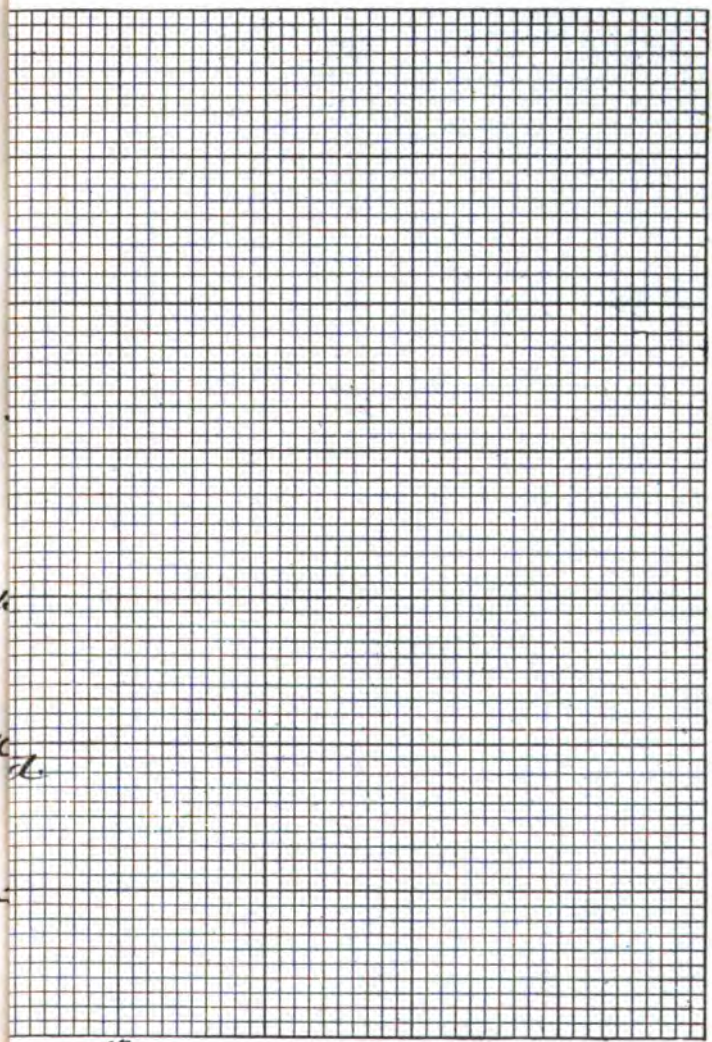

Resistance, ohms
150,0
100,0
50,0
92.5, Ni 75
12


Resistance,
150,0
100,0
50,0


12

BRONZE.

DRY SAND, GREEN SAND, AND CHILLED CASTINGS.

Metal cast at Watertown Arsenal in connection with series of tests on resistance of banded projectiles in rifled sections.

TENSION TESTS OF BRONZE CAST AT WATERTOWN ARSENAL FOUNDRY.

Specimens turned down from cast bars 2″ diameter.
Dry sand, green sand, and chilled bronze castings.

No. 2 Bronze.

No. 8221.

Marks, D2.
No. 2 bronze. Dry sand casting.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0008	.....	
3,000	.0017	.....	
4,000	.0024	.....	
5,000	.0032	0.	
6,000	.0041	.....	
7,000	.0050	.....	
8,000	.0059	.....	
9,000	.0069	.....	
10,000	.0079	.0002	
11,000	.0090	.....	
12,000	.0105	.....	
13,000	.0130	.0030	
14,000	.0180	.....	
15,000	.0300	.0179	E = 11,570,000 pounds per square inch.
16,000	.0470	.....	
17,000	.0690	.....	
18,000	.1090	.....	
19,000	.1600	.....	
20,000	.28	.....	Tensile strength.
0	.30	.....	= 3 per cent.

Elongation of inch sections, ″.03, ″.10*, ″.02, ″.03, ″.02, ″.03, ″.02, ″.02, ″.01, ″.02.
Diameter at fracture, 1″.10; area, .950 square inch.
Contraction of area, 5 per cent.
Position of fracture, 1″.97 from the neck.
Appearance of fracture, lavender and light-yellow patches.

No. 8222.

Marks, G2.
No. 2 bronze. Green sand casting.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0009	.....	
3,000	.0017	.....	
4,000	.0026	.....	
5,000	.0034	0.	
6,000	.0042	.....	
7,000	.0052	.....	
8,000	.0062	.....	
9,000	.0072	.....	
10,000	.0084	.0005	
11,000	.0100	.....	
12,000	.0120	.....	
13,000	.0155	.0050	
14,000	.0230	.....	
15,000	.0380	.0259	E = 11,570,000 pounds per square inch.
16,000	.0669	.....	
17,000	.1090	.....	
18,000	.1860	.....	Tensile strength.
0	.23	.....	= 2.3 per cent.

Elongation of inch sections, ″.04, ″.07*, ″.02, ″.02, ″.02, ″.02, ″.01, ″.01, ″.01, ″.01.
Diameter at fracture, 1″.10; area, .950 square inch.
Contraction of area, 5 per cent.
Position of fracture, 1″.3 from the neck.
Appearance of fracture, lavender and light-yellow patches.

No. 8223.

Marks, C2.
No. 2 bronze. Chill casting.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0008	.....	
3,000	.0016	.....	
4,000	.0023	.....	
5,000	.0030	0.	
6,000	.0038	.....	
7,000	.0046	.....	
8,000	.0052	.....	
9,000	.0060	.....	
10,000	.0069	.0001	
11,000	.0078	.....	
12,000	.0085	.....	
13,000	.0097	.0007	
14,000	.0109	.....	
15,000	.0124	.0020	
16,000	.0147	.....	
17,000	.0171	.....	
18,000	.0210	.0080	
19,000	.0270	.....	
20,000	.0341	.0192	
21,000	.0470	.....	
22,000	.0600	.....	
23,000	.0720	.....	
24,000	.0880	.....	
25,000	.1090	.0861	E=10,480,000 pounds per square inch.
26,000	.14	.....	
27,000	.18	.....	
28,000	.21	.....	
29,000	.27	.....	
29,100	.....	.....	Tensile strength.
0	.27	.....	=2.7 per cent.

Elongation of inch sections, ″.02, ″.02, ″.02, ″.02, ″.03, ″.02, ″.02, ″.03, ″.07*, ″.02.
Diameter at fracture, 1″.10; area, .950 square inch.
Contraction of area, 5 per cent.
Position of fracture, 1″.38 from the neck.
Appearance of fracture, dark lavender with light yellow center.

No. 8224.

Marks, D2–H.

No. 2 bronze. Dry sand casting, hammered cold. Reduced from 1″.75 to 1″.71 diameter.

Diameter, 1″.129.

Sectional area, 1 square inch.

Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0008	.....	
3,000	.0017	.....	
4,000	.0026	.....	
5,000	.0037	0.	
6,000	.0044	.....	
7,000	.0053	.....	
8,000	.0061	.....	
9,000	.0070	.....	
10,000	.0081	0.	
11,000	.0090	.....	
12,000	.0100	.....	
13,000	.0109	0.	
14,000	.0119	.....	
15,000	.0129	.0001	
16,000	.0139	.....	
17,000	.0150	.....	
18,000	.0159	.0006	
19,000	.0170	.....	
20,000	.0180	.0008	E=11,047,000 pounds per square inch.
22,000	.0208	.....	
24,000	.0240	.....	
26,000	.0280	.....	
28,000	.0341	.....	
29,700	.....	.....	Tensile strength.
0	.06	.....	=0.6 per cent.

Elongation of inch sections, 0″, ″.01, ″.04*, 0″, 0″, 0″, 0″, 0″, ″.01, 0″.

Contraction of area, inappreciable.

Position of fracture, 2″.17 from the neck.

Appearance of fracture, light lavender.

No. 8225.

Marks, G2–H.

No. 2 bronze. Green sand casting, hammered cold. Reduced from 1″.75 to 1″.67 diameter.

Diameter, 1″.129.

Sectional area, 1 square inch.

Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0009	.....	
3,000	.0020	.....	
4,000	.0029	.....	
5,000	.0038	0.	
6,000	.0048	.....	
7,000	.0058	.....	
8,000	.0068	.....	
9,000	.0078	.....	
10,000	.0087	.0001	
11,000	.0097	.....	
12,000	.0107	.....	
13,000	.0117	.0001	
14,000	.0126	.....	
15,000	.0137	.0001	
16,000	.0147	.....	
17,000	.0157	.....	
18,000	.0168	.0002	
19,000	.0179	.....	
20,000	.0190	.0007	
22,000	.0218	.....	
24,000	.0249	.....	
26,000	.0289	.0039	E=10,000,000 pounds per square inch.
26,700	.....	.....	Tensile strength.
0	.04	.....	=0.4 per cent.

Elongation of inch sections, 0″, ″.01, 0″, 0″, 0″, 0″, 0″, 0″, ″.03*, 0″.

Contraction of area, inappreciable.

Position of fracture, 1″.5 from the neck.

Appearance of fracture, light lavender and golden yellow color.

No. 8226.

Marks, C2–II.

No. 2 bronze. Chill casting, hammered cold. Reduced from 1″.75 to 1″.70 diameter.

Diameter, 1″.129.

Sectional area, 1 square inch.

Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0006	.....	
3,000	0013	.....	
4,000	0020	.....	
5,000	0028	0.	
6,000	.0036	.....	
7,000	.0042	.....	
8,000	.0050	.....	
9,000	.0059	.....	
10,000	.0066	0.	
11,000	.0071	.....	
12,000	.0079	.....	
13,000	0087	0.	
14,000	.0095	.....	
15,000	.0101	.....	
16,000	.0110	.....	
17,000	.0117	.....	
18,000	.0122	.0001	
19,000	.0130	.....	
20,000	.0139	.0001	
22,000	.0151	.....	
24,000	.0167	.....	
26,000	.0181	.0001	E=13,889,000 pounds per square inch.
30,000	.03	.....	
34,000	.04	.....	
38,000	.05	.....	
41,900	.....	.....	Tensile strength.
0	.03	.....	=0.3 per cent.

Elongation of inch sections, 0″, 0″, 0″, ″.01, 0″, 0″, 0″, ″.02*, 0″, 0″.

Contraction of area, inappreciable.

Position of fracture, 2″.35 from the neck.

Appearance of fracture, lavender with light yellow at center.

No. 8227.

Marks, D2–An.
No. 2 bronze. Dry sand casting. Annealed.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0010	.....	
3,000	.0019	.....	
4,000	.0028	.....	
5,000	.0037	.....	
6,000	.0046	.....	
7,000	.0054	.....	
8,000	.0062	.....	
9,000	.0070	.....	
10,000	.0081	.0002	
11,000	.0094	.....	
12,000	.0110	.....	
13,000	.0130	.....	
14,000	.0168	.....	
15,000	.0238	.0120	
16,000	.0430	.....	
17,000	.0750	.0600	E=10,667,000 pounds per square inch.
18,000	.11	.....	
19,000	.18	.....	
20,000	.28	.....	
21,000	.41	.....	
21,200	.....	.....	Tensile strength.
0	.45	.....	=4.5 per cent.

Elongation of inch sections, ″.04, ″.04, ″.04, ″.05, ″.11*, ″.03, ″.04, ″.04, ″.03, ″.03.
Diameter at fracture, 1″.09; area, .933 square inch.
Contraction of area, 6.7 per cent.
Position of fracture, 4″.88 from the neck.
Appearance of fracture, lavender and brownish yellow metal intermingled.

No. 8228.

Marks, G2–An.
No. 2 bronze. Green sand casting. Annealed.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0010	.....	
3,000	.0019	.....	
4,000	.0029	.....	
5,000	.0039	.0001	
6,000	.0049	.....	
7,000	.0057	.....	
8,000	.0068	.....	
9,000	.0078	.....	
10,000	.0089	.0003	
11,000	.0101	.....	
12,000	.0120	.....	
13,000	.0150	.....	
14,000	.0195	.....	
15,000	.0300	.0171	
16,000	.0500	.....	
17,000	.0835	.0680	L. = 10,325,000 pounds per square inch.
18,000	.15	.....	
18,900	.....	.....	Tensile strength.
0	.26	.....	=2.6 per cent.

Elongation of inch sections, ″.03, ″.03, ″.08*, ″.04, ″.02, ″.01, ″.02, ″.01, ″.01, ″.01.

Diameter at fracture, 1″.10; area, .950 square inch.

Contraction of area, 5 per cent.

Position of fracture, 2″.4 from the neck.

Appearance of fracture, lavender and brownish yellow. Irregular surface.

No. 8229.

Marks, C2-An.
No. 2 bronze. Chill casting. Annealed.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0009	.....	
3,000	.0017	.....	
4,000	.0024	.....	
5,000	.0032	0.	
6,000	.0040	.....	
7,000	.0048	.....	
8,000	.0057	.....	
9,000	.0063	.....	
10 000	.0071	0.	
11,000	.0081	.....	
12,000	.0092	.....	
13,000	.0101	.....	
14,000	.0112	.....	
15,000	.0130	.0020	
16,000	.0159	.....	
17,000	.0200	.....	
18,000	.0262	.....	
19,000	.0350	.....	
20,000	.0505	.0342	E—11,656,000 pounds per square inch.
21,000	.07	.....	
22,000	.10	.....	
23,000	.15	.....	
24,000	.20	.....	
25,000	.26	.....	
25,800	.....	.....	Tensile strength.
0	.28	.....	—2.8 per cent.

Elongation of inch sections, ″.03, ″.03, ″.02, ″.02, ″.03, ″.02, ″.03, ″.02, ″.03, ″.05.

Diameter at fracture, 1″.10; area, .950 square inch.

Contraction of area, 5 per cent.

Position of fracture, at the neck.

Appearance of fracture, lavender. Golden yellow, spongy spot at center, ½ inch in diameter.

No. 3 Bronze.

No. 8233.

Marks, D3.
No. 3 bronze. Dry sand casting.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0008	.....	
3,000	.0017	.....	
4,000	.0024	.....	
5,000	.0032	0.	
6,000	.0040	.....	
7,000	0050	.....	
8,000	.0058	.....	
9,000	.0067	.....	
10,000	.0077	.0001	
11,000	.0087	.....	
12,000	.0097	.....	
13,000	.0110	.....	
14,000	.0121	.....	
15,000	.0138	.0017	
16,000	.0155	.....	
17,000	.0173	.....	
18,000	.0198	.....	
19,000	.0221	.....	
20,000	.0251	.0078	
21,000	.0280	.....	
22,000	.0330	.....	
23,000	.0380	.....	
24,000	.0443	.....	
25,000	.0525	.0286	E.=10,042,000 pounds per square inch.
26,000	.0610	.....	
27,000	.0755	.....	
28,000	.0912	.....	
28,800	.....	.....	Tensile strength.
0	.13	.....	=1.3 per cent.

Elongation of inch sections, ″.01, ″.06*, ″.01, ″.01, ″.01, 0″, ″.01, ″.01, ″.01, 0″.
Diameter at fracture, 1″.09; area, .933 square inch.
Contraction of area, 6.7 per cent.
Position of fracture, 1″.41 from the neck.
Appearance of fracture, lavender and lemon yellow.

No. 8234.

Marks, G3.
No. 3 bronze. Green sand casting.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0010	.....	
3,000	.0019	.....	
4,000	.0029	.....	
5,000	.0038	0.	
6,000	.0047	.....	
7,000	.0056	.....	
8,000	.0064	.....	
9,000	.0071	.....	
10,000	.0080	.0001	
11,000	.0090	.....	
12,000	.0101	.....	
13,000	.0111	.....	
14,000	.0123	.....	
15,000	.0136	.0011	
16,000	.0148	.....	
17,000	.0162	.....	
18,000	.0180	.....	
19,000	.0199	.....	
20,000	.0219	.0043	
21,000	.0248	.....	
22,000	.0271	.....	
23,000	.0300	.....	
24,000	.0345	.....	
25,000	.0400	0160	E = 10,000,000 pounds per square inch.
27,600	.....	.....	Tensile strength.
0	.12	.....	= 1.2 per cent.

Elongation of inch sections 0″, ″.01, 0″, ″.09*, ″.01, 0″, 0″, ″.01, 0″, 0″.
Diameter at fracture, 1″.10; area, .950 square inch.
Contraction of area, 5 per cent.
Position of fracture, 3″.6 from the neck.
Appearance of fracture, lavender and lemon yellow.

No. 8235.

Marks, C3
No. 3 bronze. Chill casting.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0032	0.	
10,000	.0069	0.	
15,000	.0106	0.	
16,000	.0115	.....	
17,000	.0122	.....	
18,000	.0131	.....	
19,000	.0140	.....	
20,000	.0150	0.	
21,000	.0159	.....	
22,000	.0167	.....	
23,000	.0178	.....	
24,000	.0188	.....	
25,000	.0200	.0010	E = 12,632,000 pounds per square inch.
26,000	.0210	.....	
27,000	.0224	.....	
28,000	.0241	.....	
29,000	.0261	.....	
30,000	.0283	.0050	
32,000	.04	.....	
34,000	.05	.....	
36,000	.06	.....	
38,000	.08	.....	
40,000	.11	.....	
42,000	.14	.....	
44,000	.18	.....	
46,000	.22	.....	
48,000	.27	.....	
50,000	.31	.....	
52,000	.37	.....	
54,000	.43	.....	
56,000	.50	.....	
58,000	.58	.....	
60,000	.67	.....	
61,700	.....	.....	Tensile strength.
0	.69	.....	= 6.9 per cent.

Elongation of inch sections, ″.09*, ″.06, ″.06, ″.07, ″.06, ″.07, ″.07, ″.07, ″.07, ″.07.
Diameter at fracture, 1″.06; area, .882 square inch.
Contraction of area, 11.8 per cent.
Position of fracture, ″.55 from the neck.
Appearance of fracture, light yellow.

No. 8236.

Marks, D3–H.

No. 3 bronze. Dry sand casting, hammered cold. Reduced from 1″.75 to 1″.71 diameter.

Diameter, 1″.129.

Sectional area, 1 square inch.

Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0033	0.	
10,000	.0073	0.	
15,000	.0118	0.	
20,000	.0160	.0001	
21,000	.0168	.....	
22,000	.0177	.....	
23,000	.0188	.....	
24,000	.0196	.....	
25,000	.0204	.0003	E = 11,940,000 pounds per square inch.
26,000	.0215	.....	
27,000	.0224	.....	
28,000	.0232	.....	
29,000	.0243	.....	
30,000	.0254	.0013	
31,000	.0266	.....	
32,000	.0279	.....	
33,000	.0290	.....	
34,000	.0300	.....	
35,000	.0319	.0034	
35,000	.....	.....	Tensile strength.
0	.07	.....	= 0.7 per cent.

Elongation of inch sections, 0″, ″.01, 0″,″.04*, ″.01, 0″, ″.01, 0″, 0″, 0″.

Contraction of area, inappreciable.

Position of fracture, 3″.82 from the neck.

Appearance of fracture, light yellow. Fractured upon second application of 35,000 pounds tension.

No. 8237.

Marks, G3–H.

No. 3 bronze. Green sand casting, hammered cold. Reduced from 1″.75 to 1″.71 diameter.

Diameter, 1″.129.

Sectional area, 1 square inch.

Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0038	0.	
10,000	.0080	0.	
15,000	.0120	0.	
16,000	.0128	.....	
17,000	.0137	.....	
18,000	.0146	.....	
19,000	.0152	.....	
20,000	.0161	0.	
21,000	.0170	.....	
22,000	.0180	.....	
23,000	.0189	.....	
24,000	.0198	.....	
25,000	.0208	0.	E = 11,538,000 pounds per square inch.
26,000	.0214	.....	
27,000	.0223	.....	
28,000	.0232	.....	
29,000	.0243	.....	
30,000	.0253	.0002	
36,000	.03	.....	
40,000	.04	.....	
44,000	.05	.....	
44,500	.....	.....	Tensile strength.
0	.07	.....	= 0.7 per cent.

Elongation of inch sections, 0″, 0″, 0″, ″.01, 0″, ″.05*, 0″, 0″, 0″, ″.01.

Diameter at fracture, 1″.11; area, .968 square inch.

Contraction of area, 3.2 per cent.

Position of fracture, 4″.7 from the neck.

Appearance of fracture, light and lemon yellow.

No. 8238.

Marks, C3–H.

No. 3 bronze. Chill casting, hammered cold. Reduced from 1″.75 to 1″.72 diameter.

Diameter, 1″.129.

Sectional area, 1 square inch.

Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0031	0.	
10,000	.0068	0.	
15,000	.0104	0.	
16,000	.0111	.....	
17,000	.0119	.....	
18,000	.0127	.....	
19,000	.0132	.....	
20,000	.0140	0.	
21,000	.0148	.....	
22,000	.0154	.....	
23,000	.0161	.....	
24,000	.0169	.....	
25,000	.0175	0.	E = 13,714,000 pounds per square inch.
26,000	.0183	.....	
27,000	.0191	.....	
28,000	.0198	.....	
29,000	.0205	.....	
30,000	.0212	− .0001	
31,000	.0221	.....	
32,000	.0229	.....	
33,000	.0235	.....	
34,000	.0242	.....	
35,000	.0250	− .0001	
36,000	.0259	.....	
37,000	.0268	.....	
38,000	.0275	.....	
39,000	.0282	.....	
40,000	.0290	0.	
48,000	.04	.....	
56,000	.05	.....	
64,000	.08	.....	
66,400	.....	.....	Tensile strength.
0	.09	.....	=0.9 per cent.

Elongation of inch sections, ″.04*, ″.01, ″.01, ″.01, 0″, ″.01, 0″, 0″, ″.01, 0″.

Diameter at fracture, 1″.09; area, .933 square inch.

Contraction of area, 6.7 per cent.

Position of fracture, ″.75 from the neck.

Appearance of fracture, brownish yellow.

No. 8239.

Marks, D3–An.
No. 3 bronze. Dry sand casting. Annealed.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0004	.....	
3,000	.0013	.....	
4,000	.0021	.....	
5,000	.0029	0.	
6,000	.0035	.....	
7,000	.0046	.....	
8,000	.0052	.....	
9,000	.0062	.....	
10,000	.0070	0.	
11,000	.0079	.....	
12,000	.0090	.....	
13,000	.0100	.....	
14,000	.0112	.....	
15,000	.0127	.0010	
16,000	.0138	.....	
17,000	.0159	.....	
18,000	.0182	.....	
19,000	.0212	.....	
20,000	.0259	.0090	E=11,243,000 pounds per square inch.
20,400	.....	.....	Tensile strength.
0	.07	.....	=0.7 per cent.

Elongation of inch sections, 0″, ″.06*, 0″, ″.01, 0″, 0″, 0″, 0″, 0″, 0″.
Contraction of area, inappreciable.
Position of fracture, 1″.65 from the neck.
Appearance of fracture, brownish, lemon yellow.

No. 8240.

Marks, G3–An.
No. 3 bronze. Green sand casting. Annealed.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0007	.....	
3,000	.0014	.....	
4,000	.0022	.....	
5,000	.0031	0.	
6,000	.0040	.....	
7,000	.0050	.....	
8,000	.0058	.....	
9,000	.0068	.....	
10,000	.0076	0.	
11,000	.0083	.....	
12,000	.0091	.....	
13,000	.0100	.....	
14,000	.0110	.....	
15,000	.0122	.0003	
16,000	.0130	.....	
17,000	.0143	.....	
18,000	.0152	.....	
19,000	.0167	.....	
20,000	.0180	.0015	
21,000	.0194	.....	
22,000	.0211	.....	
23,000	.0230	.....	
24,000	.0253	.....	
25,000	.0280	.0061	E=10,959,000 pounds per square inch.
26,000	.0300	.....	
27,000	.0342	.....	
28,000	.0385	.0138	
30,000	.05	.....	
32,000	.07	.....	
34,000	.10	.....	
35,100	.....	.....	Tensile strength.
0	.15	.....	=1.5 per cent.

Elongation of inch sections, ″.01, 0″, ″.02, ″.07*, ″.01, ″.01, ″.01, 0″, ″.01, ″.01.
Diameter at fracture, 1″.11; area, .968 square inch.
Contraction of area, 3.2 per cent.
Position of fracture, 2″.24 from the neck.
Appearance of fracture, lavender and lemon yellow.

No. 8241.

Marks, C3–An.
No. 3 bronze. Chill casting. Annealed.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0007	.....	
3,000	.0013	.....	
4,000	.0020	.....	
5,000	.0029	0.	
6,000	.0034	.....	
7,000	.0041	.....	
8,000	.0050	.....	
9,000	.0056	.....	
10,000	.0062	0.	
11,000	.0070	.....	
12,000	.0078	.....	
13,000	.0086	.....	
14,000	.0092	.....	
15,000	.0100	0.	
16,000	.0108	.....	
17,000	.0114	.....	
18,000	.0122	.....	
19,000	.0132	.....	
20,000	.0142	.0003	
21,000	.0151	.....	
22,000	.0163	.....	
23,000	.0179	.....	
24,000	.0195	.....	
25,000	.0211	.0029	E=13,187,000 pounds per square inch.
26,000	.0232	.....	
27,000	.0258	.....	
28,000	.0291	.....	
29,000	.0326	.....	
30,000	.0378	.0132	
32,000	.05	.....	
34,000	.07	.....	
36,000	.10	.....	
38,000	.14	.....	
40,000	.17	.....	
42,000	.21	.....	
44,000	.26	.....	
46,000	.32	.....	
48,000	.39	.....	
50,000	.47	.....	
52,000	.54	.....	
54,000	.63	.....	
56,000	.72	.....	
58,000	.84	.....	
60,000	.96	.....	
61,100	.....	.....	Tensile strength.
0	1.09	.....	=10.9 per cent.

Elongation of inch sections, ″.10, ″.10, ″.10, ″.11, ″.11, ″.11, ″.15*, ″.10, ″.11, ″.10.
Diameter at fracture, 1″.03; area, .833 square inch.,
Contraction of area, 16.7 per cent.
Position of fracture, 4″.25 from the neck.
Appearance of fracture, fine granular. Light yellow.

No. 8242.

Marks, D3–IIH.

No. 3 bronze. Dry sand casting, hammered hot. Reduced from 1″.75 to 1″.54 diameter.

Diameter, 1″.129.

Sectional area, 1 square inch.

Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0028	0.	
10,000	.0062	0.	
11,000	.0069	.....	
12,000	.0078	.....	
13,000	.0086	.....	
14,000	.0093	.....	
15,000	.0100	0.	
16,000	.0107	.....	
17,000	.0116	.....	
18,000	.0124	.....	
19,000	.0132	.....	
20,000	.0143	0.	
21,000	.0151	.....	
22,000	.0162	.....	
23,000	.0176	.....	
24,000	.0190	.....	
25,000	.0205	.0018	E = 12,834,000 pounds per square inch.
26,000	.0219	.....	
27,000	.0236	.....	
28,000	.0260	.....	
29,000	.0284	.....	
30,000	.0320	.0080	
32,000	.04	.....	
34,000	.05	.....	
36,000	.08	.....	
38,000	.10	.....	
40,000	.13	.....	
42,000	.17	.....	
42,800	.....	.....	Tensile strength.
0	.19	.....	= 1.9 per cent.

Elongation of inch sections, ″.08*, ″.01, ″.01, ″.02, ″.01, ″.02, ″.01, ″.01, ″.01, ″.01.

Diameter at fracture, 1″.08; area, .916 square inch.

Contraction of area, 8.4 per cent.

Position of fracture, ″.35 from the neck.

Appearance of fracture, brownish yellow.

No. 8243.

Marks, G3–IIII.

No. 3 bronze. Green sand casting, hammered hot. Reduced from 1″.75 to 1″.55 diameter.

Diameter, 1″.129.

Sectional area, 1 square inch.

Gauged length, 10″.

Applied loads per square inch.	In gauged length. Elongation.	Set.	Remarks.
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0030	0.	
10,000	.0068	0.	
11,000	.0074	.....	
12,000	.0081	.....	
13,000	.0091	.....	
14,000	.0100	.....	
15,000	.0109	0.	
16,000	.0116	.....	
17,000	.0123	.....	
18,000	.0131	.....	
19,000	.0142	.....	
20,000	.0153	.0006	
21,000	.0164	.....	
22,000	.0177	.....	
23,000	.0190	.....	
24,000	.0205	.....	
25,000	.0219	.0028	E=12,565,000 pounds per square inch.
26,000	.0232	.....	
27,000	.0250	.....	
28,000	.0278	.....	
29,000	.0302	.....	
30,000	.0340	.0092	
31,000	.0368	.....	
32,000	.0420	.....	
33,000	.0472	.....	
34,000	.0550	.....	
35,000	.0650	.0350	
36,000	.08	.....	
38,000	.10	.....	
40,000	.14	.....	
42,000	.17	.....	
44,000	.22	.....	
46,000	.27	.....	
48,000	.33	.....	
50,000	.40	.....	
52,000	.48	.....	
54,000	.54	.....	
54,800	.....	.....	Tensile strength.
0	.60	.....	=6 per cent.

Elongation of inch sections, ″.05, ″.05, ″.05, ″.06, ″.06, ″.05, ″.05, ″.04, ″.07, ″.12*.

Diameter at fracture, 1″.06; area, .882 square inch.

Contraction of area, 11.8 per cent.

Position of fracture, 1″ from the neck.

Appearance of fracture, lavender and light yellow.

No. 8244.

Marks, C3–IIII.

No. 3 bronze. Chill casting, hammered hot. Reduced from 1″.75 to 1″.56 diameter.

Diameter, 1″.129.

Sectional area, 1 square inch.

Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,600	.0032	.0001	
10,000	.0071	.0003	
11,000	.0079	.....	
12,000	.0088	.....	
13,000	.0095	.....	
14,000	.0102	.....	
15,000	.0111	.0004	
16,000	.0118	.....	
17,000	.0127	.....	
18,000	.0137	.....	
19,000	.0147	.....	
20,000	.0155	.0007	
21,000	.0165	.....	
22,000	.0177	.....	
23,000	.0189	.....	
24,000	.0202	.....	
25,000	.0217	.0024	E=12,435,000 pounds per square inch.
26,000	.0229	.....	
27,000	.0248	.....	
28,000	.0270	.....	
29,000	.0298	.....	
30,000	.0327	.0083	
31,000	.0356	.....	
32,000	.0405	.....	
33,000	.0460	.....	
34,000	.0540	.....	
35,000	.0620	.0325	
38,000	.09	.....	
40,000	.12	.....	
42,000	.17	.....	
44,000	.21	.....	
46,000	.26	.....	
48,000	.31	.....	
50,000	.38	.....	
52,000	.44	.....	
54,000	.50	.....	
56,000	.59	.....	
58,000	.68	.....	
60,000	.78	.....	
62,000	.98	.....	
64,000	1.18	.....	
65,800	.....	.....	Tensile strength.
0	1.23	.....	=12.3 per cent.

Elongation of inch sections, ″.11, ″.12, ″.12, ″.12, ″.11, ″.10, ″.12, ″.12, ″.15, ″.16*.

Diameter at fracture, 1″.02; area, .817 square inch.

Contraction of area, 18.3 per cent.

Position of fracture, 1″.30 from the neck.

Appearance of fracture, uniform, brownish yellow.

No. 4 Bronze.

No. 8245.

Marks, D4.
No. 4 bronze. Dry sand casting.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0008	.....	
3,000	.0016	.....	
4,000	.0025	.....	
5,000	.0033	0.	
6,000	.0042	.....	
7,000	.0050	.....	
8,000	.0059	.....	
9,000	.0068	.....	
10,000	.0077	.0001	
11,000	.0084	.....	
12,000	.0095	.....	
13,000	.0103	.....	
14,000	.0112	.....	
15,000	.0126	.0010	
16,000	.0137	.....	
17,000	.0151	.....	
18,000	.0166	.....	
19,000	.0181	.....	
20,000	.0200	.0032	
21,000	.0217	.....	
22,000	.0240	.....	
23,000	.0262	.....	
24,000	.0294	.....	
25,000	.0327	.0109	E = 11,009,000 pounds per square inch.
26,000	.0360	.....	
27,000	.0410	.....	
28,000	.0465	.....	
29,000	.0540	.....	
30,000	.0620	.0339	
31,000	.07	.....	
32,000	.09	.....	
33,000	.10	.....	
34,000	.12	.....	
36,000	.15	.....	
38,000	.19	.....	
38,600	.....	.....	Tensile strength.
0	.29	.....	=2.9 per cent.

Elongation of inch sections, ″.01, ″.02, ″.02, ″.02, ″.02, ″.01, ″.01, ″.01, ″.16*, ″.01.
Diameter at fracture, 1″.10; area, .95 square inch.
Contraction of area, 5 per cent.
Position of fracture, 2″.07 from the neck.
Appearance of fracture, lemon yellow and lavender.

No. 8246.

Marks, G4.
No. 4 bronze. Green sand casting.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0009	.....	
3,000	.0018	.....	
4,000	.0026	.....	
5,000	.0033	0.	
6,000	.0040	.....	
7,000	.0050	.....	
8,000	.0060	.....	
9,000	.0067	.....	
10,000	.0073	0.	
11,000	.0082	.....	
12,000	.0091	.....	
13,000	.0101	.....	
14,000	.0111	.....	
15,000	.0121	.0007	
16,000	.0130	.....	
17,000	.0141	.....	
18,000	.0153	.....	
19,000	.0169	.....	
20,000	.0181	.0021	
21,000	.0197	.....	
22,000	.0215	.....	
23,000	.0237	.....	
24,000	.0260	.....	
25,000	.0288	.0074	E=11,215,000 pounds per square inch.
26,000	.0312	.....	
27,000	.0351	.....	
28,000	.0401	.....	
29,000	.0453	.....	
30,000	.0519	.0249	
32,000	.06	.....	
34,000	.09	.....	
36,000	.11	.....	
38,000	.15	.....	
38,700	.....	.....	Tensile strength.
0	.20	.....	=2 per cent.

Elongation of inch sections, ″.10*, ″.01, ″.01, ″.02, ″.01, ″.01, ″.01, ″.01, ″.01. ″.01.
Diameter at fracture, 1″.09; area, .933 square inch.
Contraction of area, 6.7 per cent.
Position of fracture, at the neck.
Appearance of fracture, lavender and lemon yellow.

No. 8247.

Marks, C4.
No. 4 bronze. Chill casting.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0029	0.	
10,000	.0068	0.	
11,000	.0076	.....	
12,000	.0082	.....	
13,000	.0090	.....	
14,000	.0097	.....	
15,000	.0103	0.	
16,000	.0111	.....	
17,000	.0120	.....	
18,000	.0128	.....	
19,000	.0136	.....	
20,000	.0142	0.	
21,000	.0151	.....	
22,000	.0159	.....	
23,000	.0168	.....	
24,000	.0175	.....	
25,000	.0183	.0003	E=13,333,000 pounds per square inch.
26,000	.0192	.....	
27,000	.0203	.....	
28,000	.0216	.....	
29,000	.0230	.....	
30,000	.0242	.0021	
31,000	.0259	.....	
32,000	.0278	.....	
33,000	.0300	.....	
34,000	.0328	.....	
35,000	.0355	.0089	
38,000	.05	.....	
42,000	.08	.....	
46,000	.13	.....	
50,000	.21	.....	
54,000	.29	.....	
58,000	.40	.....	
62,000	.54	.....	
64,000	.61	.....	
66,000	.79	.....	
68,000	.87	.....	
69,600	.....	.....	Tensile strength.
0	.98	.....	=9.8 per cent.

Elongation of inch sections, ″.09, ″.09, ″.10, ″.09, ″.09, ″.09, ″.10, ″.14*, ″.10, ″.09.
Diameter at fracture, 1″.04; area, .849 square inch.
Contraction of area, 15.1 per cent.
Position of fracture, 2″.73 from the neck.
Appearance of fracture, light yellow, radiating from the center.

No. 8248.

Marks, D4–H.

No. 4 bronze. Dry sand casting, hammered cold. Reduced from 1″.75 to 1″.71 diameter.

Diameter, 1″.129.

Sectional area, 1 square inch.

Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0030	0.	
10,000	.0068	0.	
15,000	.0109	0.	
16,000	.0116	.....	
17,000	.0123	.....	
18,000	.0130	.....	
19,000	.0137	.....	
20,000	.0144	0.	
21,000	.0151	.....	
22,000	.0159	.....	
23,000	.0166	.....	
24,000	.0173	.....	
25,000	.0181	—.0001	E=13,187,000 pounds per square inch.
26,000	.0190	.....	
27,000	.0200	.....	
28,000	.0209	.....	
29,000	.0219	.....	
30,000	.0229	0.	
31,000	.0237	.....	
32,000	.0249	.....	
33,000	.0258	.....	
34,000	.0270	.....	
35,000	.0281	.0012	
36,000	.0293	.....	
37,000	.0308	.....	
38,000	.0322	.....	
39,000	.0338	.....	
40,000	.0353	.0042	
44,000	.05	.....	
45,800	.....	.....	Tensile strength.
0	.08	.....	=0.8 per cent.

Elongation of inch sections, ″.01, 0″, 0″, 0″, 0″, 0″, 0″, ″.06*, ″.01, 0″.

Diameter at fracture, 1″.10; area, .95 square inch.

Contraction of area, 5 per cent.

Position of fracture, 3″ from the neck.

Appearance of fracture, light yellow and lemon yellow.

No. 8249.

Marks, G4–H.

No. 4 bronze. Green sand casting, hammered cold. Reduced from 1″.75 to 1″.67 diameter.

Diameter, 1″.129.

Sectional area, 1 square inch.

Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0032	0.	
10,000	.0072	0.	
15,000	.0111	0.	
16,000	.0120	.....	
17,000	.0129	.....	
18,000	.0135	.....	
19,000	.0142	.....	
20,000	.0150	−.0001	
21,000	.0157	.....	
22,000	.0165	.....	
23,000	.0172	.....	
24,000	.0181	.....	
25,000	.0190	0.	E=12,632,000 pounds per square inch.
26,000	.0197	.....	
27,000	.0204	.....	
28,000	.0212	.....	
29,000	.0221	.....	
30,000	.0231	0.	
31,000	.0239	.....	
32,000	.0248	.....	
33,000	.0258	.....	
34,000	.0267	.....	
35,000	.0278	.0007	
36,000	.0289	.....	
37,000	.0298	.....	
38,000	.0310	.....	
39,000	.0326	.....	
40,000	.0340	.0024	
44,000	.04	.....	
47,100	.....	.....	Tensile strength.
0	.07	.....	=0.7 per cent.

Elongation of inch sections, 0″, 0″, 0″, ″.01, ″.01, ″.04*, ″.01, 0″, 0″, 0″.

Contraction of area, inappreciable.

Position of fracture, 4″.35 from the neck.

Appearance of fracture, lemon yellow; in part lavender.

No. 8250.

Marks, C4–H.

No. 4 bronze. Chill casting, hammered cold. Reduced from 1″.75 to 1″.70 diameter.

Diameter, 1″.129.

Sectional area, 1 square inch.

Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0028	0.	
10,000	.0060	0.	
15,000	.0098	0.	
20,000	.0132	0.	
25,000	.0166	0.	E=14,458,000 pounds per square inch.
26,000	.0172	.....	
27,000	.0180	.....	
28,000	.0187	.....	
29,000	.0193	.....	
30,000	.0201	0.	
31,000	.0208	.....	
32,000	.0214	.....	
33,000	.0222	.....	
34,000	.0230	.....	
35,000	.0238	0.	
36,000	.0246	.....	
37,000	.0253	.....	
38,000	.0261	.....	
39,000	.0269	.....	
40,000	.0278	.0001	
41,000	.0289	.....	
42,000	.0298	.....	
43,000	.0307	.....	
44,000	.0318	.....	
45,000	.0328	.0011	
46,000	.0337	.....	
47,000	.0349	.....	
48,000	.0361	.....	
49,000	.0378	.....	
50,000	.0390	.0034	
54,000	.05	.....	
58,000	.06	.....	
62,000	.07	.....	
64,000	.09	.....	
66,000	.12	.....	
68,000	.15	.....	
70,000	.19	.....	
72,000	.24	.....	
74,000	.31	.....	
76,000	.40	.....	
77,400	.....	.....	Tensile strength.
0	.41	.....	=4.1 per cent.

Elongation of inch sections, ″.03, ″.07, ″.12*, ″.06, ″.04, ″.03, ″.03, ″.01, ″.01, ″.01.

Diameter at fracture, 1″.04; area, .849 square inch.

Contraction of area, 15.1 per cent.

Position of fracture, 2″.6 from the neck.

Appearance of fracture, fine granular. Uniform light yellow.

No. 8251.

Marks, D4–An.
No. 4 bronze. Dry sand casting. Annealed.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0009	.....	
3,000	.0018	.....	
4,000	.0027	.....	
5,000	.0034	0.	
6,000	.0043	.....	
7,000	.0050	.....	
8,000	.0059	.....	
9,000	.0066	.....	
10,000	.0073	0.	
11,000	0081	.....	
12,000	.0091	.....	
13,000	.0100	.....	
14,000	.0109	.....	
15,000	.0118	.0002	
16,000	.0128	.....	
17,000	.0138	.....	
18,000	.0149	.....	
19,000	.0160	.....	
20,000	.0171	.0012	
21,000	.0183	.....	
22,000	.0199	.....	
23,000	.0217	.....	
24,000	.0236	.....	
25,000	.0258	.0050	E=11,538,000 pounds per square inch.
26,000	.0277	.....	
27,000	.0310	.....	
28,000	.0340	.....	
29,000	.0380	.....	
30,000	.0427	.0169	
32,000	.05	.....	
34,000	.07	.....	
36,000	.09	.....	
37,800	.....	.....	Tensile strength.
0	.17	.....	=1.7 per cent.

Elongation of inch sections, ″.01, ″.01, 0″, ″.02, ″.01, 0″, 0″, 0″, ″.02, ″.10*.
Diameter at fracture, 1″.10; area, .95 square inch.
Contraction of area, 5 per cent.
Position of fracture, ″.80 from the neck.
Appearance of fracture, lavender and lemon yellow.

No. 8252.

Marks, G4–An.
No. 4 bronze. Green sand casting. Annealed.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0009	.....	
3,000	.0017	.....	
4,000	.0026	.....	
5,000	.0034	0.	
6,000	.0041	.....	
7,000	.0050	.....	
8,000	.0059	.....	
9,000	.0068	.....	
10,000	.0076	0.	
11,000	.0085	.....	
12,000	.0093	.....	
13,000	.0101	.....	
14,000	.0111	.....	
15,000	.0120	.0002	
16,000	.0130	.....	
17,000	.0140	.....	
18,000	.0152	.....	
19,000	.0165	.....	
20,000	.0179	.0017	
21,000	.0192	.....	
22,000	.0211	.....	
23,000	.0231	.....	
24,000	.0254	.....	
25,000	.0279	.0064	E=11,163,000 pounds per square inch.
26,000	.0305	.....	
27,000	.0345	.....	
28,000	.0390	.....	
29,000	.0445	.....	
30,000	.0500	.0224	
32,000	.07	.....	
33,900	.....	.....	Tensile strength.
0	.13	.....	=1.3 per cent.

Elongation of inch sections, ″.01, 0″, 0″, ″.01, ″.09*, 0″, 0″, ″.01, ″.01, 0″.
Diameter at fracture, 1″.10; area, .95 square inch.
Contraction of area, 5 per cent.
Position of fracture, 4″.4 from the neck.
Appearance of fracture, lavender and lemon yellow.

No. 8253.

Marks, C4–An.
No. 4 bronze. Chill casting. Annealed.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0029	0.	
10,000	.0067	0.	
11,000	.0073	.....	
12,000	.0080	.....	
13,000	.0088	.....	
14,000	.0096	.....	
15,000	.0102	0.	
16,800	.0110	.....	
17,000	.0118	.....	
18,000	.0128	.....	
19,000	.0134	.....	
20,000	.0142	.0002	
21,000	.0151	.....	
22,000	.0161	.....	
23,000	.0172	.....	
24,000	.0185	.....	
25,000	.0200	.0015	E=12,973,000 pounds per square inch.
26,000	.0213	.....	
27,000	.0231	.....	
28,000	.0242	.....	
29,000	.0279	.....	
30,000	.0309	.0071	
31,000	.0335	.....	
32,000	.0381	.....	
33,000	.0432	.....	
34,000	.0497	.....	
35,000	.0562	.0271	
38,000	.08	.....	
40,000	.11	.....	
42,000	.14	.....	
44,000	.18	.....	
46,000	.22	.....	
48,000	.26	.....	
50,000	.32	.....	
52,000	.39	.....	
54,000	.46	.....	
56,000	.53	.....	
58,000	.62	.....	
60,000	.70	.....	
62,000	.80	.....	
63,900	.....	.....	Tensile strength.
0	.86	.....	=8.6 per cent.

Elongation of inch sections, ″.08, ″.08, ″.09, ″.14*, ″.07, ″.09, ″.08, ″.08, ″.08, ″.07.
Diameter at fracture, 1″.04; area, .849 square inch.
Contraction of area, 15.1 per cent.
Position of fracture, 3″.53 from the neck.
Appearance of fracture, light yellow, radiating from a small (″.05 by ″.15) spot of light silvery metal at the circumference.

No. 8254.

Marks, D4–HH.

No. 4 bronze. Dry sand casting, hammered hot. Reduced from 1″.75 to 1″.59 diameter.

Diameter, 1″.129.

Sectional area, 1 square inch.

Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0028	0.	
10,000	.0063	0.	
11,000	.0069	.....	
12,000	.0077	.....	
13,000	.0083	.....	
14,000	.0091	.....	
15,000	.0099	0.	
16,000	.0107	.....	
17,000	.0115	.....	
18,000	.0123	.....	
19,000	.0131	.....	
20,000	.0141	.0003	
21,000	.0150	.....	
22,000	.0160	.....	
23,000	.0171	.....	
24,000	.0182	.....	
25,000	.0197	.0018	E = 13,408,000 pounds per square inch.
26,000	.0209	.....	
27,000	.0222	.....	
28,000	.0240	.....	
29,000	.0262	.....	
30,000	.0283	.0058	
31,000	.0309	.....	
32,000	.0340	.....	
33,000	.0380	.....	
34,000	.0422	.....	
35,000	.0483	.0208	
38,000	.07	.....	
40,000	.09	.....	
42,000	.12	.....	
44,000	.16	.....	
46,000	.20	.....	
48,000	.25	.....	
50,000	.29	.....	
52,000	.35	.....	
54,000	.41	.....	
55,100	.....	.....	Tensile strength.
0	.44	.....	= 4.4 per cent.

Elongation of inch sections, ″.10*, ″.04, ″.04, ″.04, ″.04, ″.03, ″.03, ″.04, ″.04, ″.04.

Diameter at fracture, 1″.06; area, .882 square inch.

Contraction of area, 11.8 per cent.

Position of fracture, ″.90 from the neck.

Appearance of fracture, lavender, interspersed with lemon yellow colored metal.

No. 8255.

Marks, G4–HH.

No. 4 bronze. Green sand casting, hammered hot. Reduced from 1″.75 to 1″.59 diameter.

Diameter, 1″.129.

Sectional area, 1 square inch.

Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0029	0.	
10,000	.0066	.0001	
11,000	.0073	.....	
12,000	.0080	.....	
13,000	.0087	.....	
14,000	.0095	.....	
15,000	.0101	.0001	
16,000	.0110	.....	
17,000	.0119	.....	
18,000	.0128	.....	
19,000	.0137	.....	
20,000	.0147	.0008	
21,000	.0156	.....	
22,000	.0165	.....	
23,000	.0178	.....	
24,000	.0190	.....	
25,000	.0202	.0025	E=13,559,000 pounds per square inch.
26,000	.0218	.....	
27,000	.0237	.....	
28,000	.0256	.....	
29,000	.0281	.....	
30,000	.0308	.0080	
31,000	.0335	.....	
32,000	.0378	.....	
33,000	.0428	.....	
34,000	.0480	.....	
35,000	.0550	.0271	
38,000	.08	.....	
40,000	.11	.....	
42,000	.14	.....	
44,000	.18	.....	
46,000	.23	.....	
48,000	.29	.....	
50,000	.34	.....	
52,000	.40	.....	
53,100	.....	.....	Tensile strength.
0	.43	.....	=4.3 per cent.

Elongation of inch sections, ″.04, ″.04, ″.11*, ″.05, ″.03, ″.03, ″.03, ″.03, ″.04, ″.03.

Diameter at fracture, 1″.08; area, .916 square inch.

Contraction of area, 8.4 per cent.

Position of fracture, 3″.15 from the neck.

Appearance of fracture, brownish yellow.

No. 8256.

Marks, C4–HH.

No. 4 bronze. Chill casting, hammered hot. Reduced from 1″.75 to 1″.54 diameter.

Diameter, 1″.129.

Sectional area, 1 square inch.

Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0025	0.	
10,000	.0068	0.	
15,000	.0100	0.	
16,000	.0108	.....	
17,000	.0116	.....	
18,000	.0123	.....	
19,000	.0130	.....	
20,000	.0138	.0001	
21,000	.0147	.....	
22,000	.0156	.....	
23,000	.0165	.....	
24,000	.0177	.....	
25,000	.0190	.0011	E=13,408,000 pounds per square inch.
26,000	.0202	.....	
27,000	.0214	.....	
28,000	.0230	.....	
29,000	.0254	.....	
30,000	.0279	.0051	
31,000	.0302	.....	
32,000	.0337	.....	
33,000	.0372	.....	
34,000	.0420	.....	
35,000	.0480	.0210	
38,000	.07	.....	
40,000	.10	.....	
42,000	.13	.....	
44,000	.17	.....	
46,000	.21	.....	
48,000	.26	.....	
50,000	.31	.....	
52,000	.36	.....	
54,000	.43	.....	
56,000	.50	.....	
58,000	.58	.....	
60,000	.66	.....	
62,000	.79	.....	
64,000	.94	.....	
66,000	1.07	.....	
68,000	1.21	.....	
70,000	1.39	.....	
72,000	1.60	.....	
72.900	.....	.....	Tensile strength.
0	1.62	.....	=16.2 per cent.

Elongation of inch sections, ″.15, ″.16, ″.15, ″.15, ″.15, ″.21*, ″.17, ″.16, ″.17, ″.15.

Diameter at fracture, ″.99; area, .77 square inch.

Contraction of area, 23 per cent.

Position of fracture, 5″.25 from the neck.

Appearance of fracture, fine granular. Uniform light yellow.

TABULATION OF TENSION SPECIMENS, BRONZE CAST AT WATERTOWN ARSENAL FOUNDRY.

NO. 2 BRONZE.

No. of test.	Marks.	Treatment.	Tensile strength per square inch.	Elongation in 10 inches.	Contraction of area.	Modulus of elasticity per square inch.	Elongation of inch sections.	Appearance of fracture.
			Pounds.	*Per cent.*	*Per cent.*	*Pounds.*	" " " " "	
8221	D2.....	Dry sand casting.....	20,000	3.0	5.0	11,570,000	.03, .10*, .02, .03, .02, .03, .02, .02, .01, .02	Lavender and light yellow patches.
8222	G2.....	Green sand casting.....	18,000	2.3	5.0	11,570,000	.04, .07*, .02, .02, .02, .02, .01, .01, .01, .01	Do.
8223	C2.....	Chill casting.....	29,100	2.7	5.0	10,480,000	.02, .02, .02, .02, .03, .02, .02, .03, .07*, .02	Dark lavender; light yellow center.
8224	D2-H.....	Dry sand casting, hammered cold. Reduced from 1".75 to 1".71 diameter.	29,700	0.6	(a)	11,047,000	.00, .01, .04*, .00, .00, .00, .00, .00, .01, .00	Light lavender.
8225	G2-H.....	Green sand casting, hammered cold. Reduced from 1".75 to 1".67 diameter.	26,700	0.4	(a)	10,000,000	.00, .01, .00, .00, 00, .00, .00, .00, .03*, .00	Light lavender and golden yellow.
8226	C2-H.....	Chill casting, hammered cold. Reduced from 1".75 to 1".70 diameter.	41,900	0.3	(a)	13,889,000	.00, .00, .00, .01, .00, .00, .00, .02, .00, .00	Lavender; light yellow at center.
8227	D2-An....	Dry sand casting, annealed.....	21,200	4.5	6.7	10,667,000	.04, .04, .04, .05, .11*, .03, .04, .04, .03, .03	Lavender and brownish metal intermingled.
8228	G2-An....	Green sand casting, annealed.....	18,900	2.6	5.0	10,323,000	.03, .03, .08*, .04, .02, .01, .02, .01, .01, .01	Lavender and brownish yellow; irregular surface.
8229	C2-An....	Chill casting, annealed.....	25,800	2.8	5.0	11,656,000	.03, .03, .02, .02, .03, .02, .03, .02, .03, .05	Lavender; golden yellow; spongy spot at center.

NO. 3 BRONZE.

8233	D3.....	Dry sand casting.....	28,800	1.3	6.7	10,042,000	.01, .06*, .01, .01, .01, .00, .01, .01, .01, .00	Lavender and lemon yellow.
8234	G3.....	Green sand casting.....	27,600	1.2	5.0	10,000,000	.00, .01, .00, .09*, .01, .00, .00, .01, .00, .00,	Do.
8235	C3.....	Chill casting.....	61,700	6.9	11.8	12,632,000	.09*, .06, .06, .07, .06, .07, .07, .07, .07, .07	Light yellow.
8236	D3-H.....	Dry sand casting, hammered cold. Reduced from 1".75 to 1".71 diameter.	35,000	0.7	(a)	11,940,000	.00, .01, .00, .04*, .01, .00, .01, .00, .00, .00,	Do.
8237	G3-H.....	Green sand casting, hammered cold. Reduced from 1".75 to 1".71 diameter.	44,500	0.7	3.2	11,538,000	.00, .00, .00, .01, .00, .05*, .00, .00, .00, .01	Light and lemon yellow.
8238	C3-H.....	Chill casting, hammered cold. Reduced from 1".75 to 1".72 diameter.	66,400	0.9	6.7	13,714,000	.04*, .01, .01, .01, .00, .01, .00, .00, .01, .00	Brownish yellow.
8239	D3-An....	Dry sand casting, annealed.....	20,400	0.7	(a)	11,243,000	.00, .06*, .00, .01, .00, .00, .00, .00, .00, .00	Brownish, lemon yellow.

8240	G3-An....	Green sand casting, annealed.....	35,100	1.5	3.2	10,959,000	.01, .00, .02, .07*, .01, .01, .01, .00, .01, .01	Lavender and lemon yellow.
8241	C3-An....	Chill casting, annealed.....	61,100	10.9	16.7	13,187,000	.10, .10, .10, .11, .11, .11, .15*, .10, .11, .10	Fine granular; light yellow.
8242	D3-HH...	Dry sand casting, hammered hot. Reduced from 1".75 to 1".54 diameter.	42,800	1.9	8.4	12,834,000	.08*, .01, .01, .02, .01, .02, .01, .01, .01, .01	Brownish yellow.
8243	G3-HH...	Green sand casting, hammered hot. Reduced from 1".75 to 1".55 diameter.	54,800	6.0	11.8	12,565,000	.05, .05, .05, .06, .06, .05, .05, .04, .07, .12*	Lavender and light yellow.
8244	C3-HH....	Chill casting, hammered hot. Reduced from 1".75 to 1".56 diameter.	65,800	12.3	18.3	12,435,000	.11, .12, .12, .12, .11, .10, .12, .12, .15, .16*	Uniform, brownish yellow.

NO. 4 BRONZE.

8245	D4.....	Dry sand casting.....	38,600	2.9	5.0	11,009,000	.01, .02, .02, .02, .02, .01, .01, .01, .16*, .01	Lemon yellow and lavender
8246	G4.....	Green sand casting.....	38,700	2.0	6.7	11,215,000	.10*, .01, .01, .02, .01, .01, .01, .01, .01, .01	Lavender and lemon yellow.
8247	C4.....	Chill casting.....	69,600	9.8	15.1	13,333,000	.09, .09, .10, .09, .09, .09, .10, .14*, .10, .09	Light yellow, radiating from center.
8248	D4-H.....	Dry sand casting, hammered cold. Reduced from 1".75 to 1".71 diameter.	45,800	0.8	5.0	13,187,000	.01, .00, .00, .00, .00, .00, .00, .06*, .01, .00	Light and lemon yellow.
8249	G4-H.....	Green sand casting, hammered cold. Reduced from 1".75 to 1".67 diameter.	47,100	0.7	(a)	12,632,000	.00, .00, .00, .01, .01, .04*, .01, .00, .00, .00	Lemon yellow; in part lavender.
8250	C4-H.....	Chill casting, hammered cold. Reduced from 1".75 to 1".70 diameter.	77,400	4.1	15.1	14,458,000	.03, .07, .12*, .06, .04, .03, .03, .01, .01, .01	Fine granular; uniform light yellow.
8251	D4-An....	Dry sand casting, annealed.....	37,800	1.7	5.0	11,538,000	.01, .01, .00, .02, .01, .00, .00, .00, .02, .10*	Lavender and lemon yellow.
8252	G4-An....	Green sand casting, annealed.....	33,900	1.3	5.0	11,163,000	.01, .00, .00, .01 .09*, .00, .00, .01, .01, .00	Do.
8253	C4-An....	Chill casting, annealed.....	63,900	8.6	15.1	12,973,000	.08, .08, .09, .14*, .07, .09, .08, .08, .08, .07	Light yellow, radiating from silvery spot at circumference.
8254	D4-HH...	Dry sand casting, hammered hot. Reduced from 1".75 to 1".59 diameter.	55,100	4.4	11.8	13,408,000	.10*, .04, .04, .04, .04, .03, .03, .04, .04, .04	Lavender and lemon yellow.
8255	G4-HH...	Green sand casting, hammered hot. Reduced from 1".75 to 1".59 diameter.	53,100	4.3	8.4	13,559,000	.04, .04, .11*, .05, .03, .03, .03, .03, .04, .03	Brownish yellow.
8256	C4-HH...	Chill casting, hammered hot. Reduced from 1".75 to 1".54 diameter.	72,900	16.2	23.0	13,408,000	.15, .16, .15, .15, .15, .21*, .17, .16, .17, .15	Fine granular; uniform light yellow.

a Inappreciable.

COMPRESSION TESTS OF BRONZE CAST AT WATERTOWN ARSENAL FOUNDRY.

Specimens turned down from cast bars 2″ diameter.

No. 2 BRONZE.

No. 1216.

Marks, D2.
No. 2 bronze. Dry sand casting.
Length of specimen, 12″.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Compression.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0008	.....	
3,000	.0018	.....	
4,000	.0026	.....	
5,000	.0031	0.	
6,000	.0040	.....	
7,000	.0051	.....	
8,000	.0059	.....	
9,000	.0070	.....	
10,000	.0080	.0009	
11,000	.0095	.....	
12,000	.0110	.....	
13,000	.0139	.....	
14,000	.0175	.....	
15,000	.0262	.0147	
16,000	.0390	.....	
18,200	.....	.....	Ultimate strength.

Failed by triple flexure.

No. 1217.

Marks, G2.
No. 2 bronze. Green sand casting.
Length of specimen, 12″.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Compression.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0008	.....	
3,000	.0016	.....	
4,000	.0023	.....	
5,000	.0031	0.	
6,000	.0040	.....	
7,000	.0050	.....	
8,000	.0059	.....	
9,000	.0068	.....	
10,000	.0078	.0006	
11,000	.0093	.....	
12,000	.0105	.....	
13,000	.0128	.....	
14,000	.0169	.....	
15,000	.0240	.0125	
18,500	.....	.....	Ultimate strength.

Failed by triple flexure.

No. 1218.

Marks, C2.
No. 2 bronze. Chill casting.
Length of specimen, 12″.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Compression.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0008	.....	
3,000	.0013	.....	
4,000	.0020	.....	
5,000	.0026	0.	
6,000	.0032	.....	
7,000	.0039	.....	
8,000	.0048	.....	
9,000	.0053	.....	
10,000	.0060	.0001	
11,000	.0069	.....	
12,000	.0074	.....	
13,000	.0081	.....	
14,000	.0090	.....	
15,000	.0100	.0008	
16,000	.0110	.....	
17,000	.0127	.....	
18,000	.0148	.....	
19,000	.0172	.....	
20,000	.0219	.0090	
25,900	.....	.....	Ultimate strength.

Failed by triple flexure.

No. 3 Bronze.

No. 1219.

Marks, D3.
No. 3 bronze. Dry sand casting.
Length of specimen, 12″.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Compression.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0008	.....	
3,000	.0018	.....	
4,000	.0026	.....	
5,000	.0031	0.	
6,000	.0040	.....	
7,000	.0049	.....	
8,000	.0056	.....	
9,000	.0067	.....	
10,000	.0077	.0005	
11,000	.0088	.....	
12,000	.0097	.....	
13,000	.0109	.....	
14,000	.0122	.....	
15,000	.0139	.0024	
16,000	.0154	.....	
17,000	.0177	.....	
18,000	.0200	.....	
19,000	.0230	.....	
20,000	.0263	.0098	
30,200	.....	.....	Ultimate strength.

Failed by triple flexure.

No. 1220.

Marks, G3.
No. 3 bronze. Green sand casting.
Length of specimen, 12″.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Compression.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0008	.....	
3,000	.0017	.....	
4,000	.0024	.....	
5,000	.0031	.0001	
6,000	.0041	.....	
7,000	.0050	.....	
8,000	.0058	.....	
9,000	.0068	.....	
10,000	.0075	.0002	
11,000	.0084	.....	
12,000	.0092	.....	
13,000	.0100	.....	
14,000	.0111	.....	
15,000	.0121	.0008	
16,000	.0133	.....	
17,000	.0148	.....	
18,000	.0160	.....	
19,000	.0177	.....	
20,000	.0198	.0037	
21,000	.0218	.....	
22,000	.0241	.....	
23,000	.0274	.....	
24,000	.0310	.....	
25,000	.0352	.0141	
31,100	.....	.....	Ultimate strength

Failed by triple flexure.

No. 1221.

Marks, C3.
No. 3 bronze. Chill casting.
Length of specimen, 12″.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Compression.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0007	.....	
3,000	.0014	.....	
4,000	.0020	.....	
5,000	.0028	0.	
6,000	.0036	.....	
7,000	.0042	.....	
8,000	.0050	.....	
9,000	.0057	.....	
10,000	.0063	.0001	
11,000	.0070	.....	
12,000	.0079	.....	
13,000	.0086	.....	
14,000	.0094	.....	
15,000	.0101	.0001	
16,000	.0109	.....	
17,000	.0118	.....	
18,000	.0124	.....	
19,000	.0133	.....	
20,000	.0143	.0006	
21,000	.0151	.....	
22,000	.0162	.....	
23,000	.0174	.....	
24,000	.0190	.....	
25,000	.0208	.0029	
26,000	.0225	.....	
27,000	.0252	.....	
28,000	.0283	.....	
29,000	.0321	.....	
30,000	.0370	.0146	
36,400	.....	.....	Ultimate strength.

Failed by triple flexure.

No. 4 Bronze.

No. 1222.

Marks, D4.
No. 4 bronze. Dry sand casting.
Length of specimen, 12″.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Compression.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0009	.....	
3,000	.0016	.....	
4,000	.0022	.....	
5,000	.0030	.0001	
6,000	.0038	.....	
7,000	.0047	.....	
8,000	.0054	.....	
9,000	.0061	.....	
10,000	.0070	.0003	
11,000	.0080	.....	
12,000	.0088	.....	
13,000	.0097	.....	
14,000	.0108	.....	
15,000	.0118	.0009	
16,000	.0128	.....	
17,000	.0140	.....	
18,000	.0151	.....	
19,000	.0169	.....	
20,000	.0182	.0030	
21,000	.0200	.....	
22,000	.0224	.....	
23,000	.0250	.....	
24,000	.0282	.....	
25,000	.0320	.0118	
31,300	.....	.....	Ultimate strength.

Failed by triple flexure.

No. 1223.

Marks, G4.
No. 4 bronze. Green sand casting.
Length of specimen, 12″.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Compression.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0009	.....	
3,000	.0016	.....	
4,000	.0022	.....	
5,000	.0029	0.	
6,000	.0037	.....	
7,000	.0046	.....	
8,000	.0052	.....	
9,000	.0060	.....	
10,000	.0069	.0003	
11,000	.0078	.....	
12,000	.0085	.....	
13,000	.0093	.....	
14,000	.0102	.....	
15,000	.0111	.0006	
16,000	.0121	.....	
17,000	.0131	.....	
18,000	.0142	.....	
19,000	.0155	.....	
20,000	.0168	.0020	
21,000	.0185	.....	
22,000	.0202	.....	
23,000	.0226	.....	
24,000	.0252	.....	
25,000	.0286	.0088	
33,700	.....	.....	Ultimate strength.

Failed by triple flexure.

No. 1224.

Marks, C4.
No. 4 bronze. Chill casting.
Length of specimen, 12″.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Compression.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0007	.....	
3,000	.0014	.....	
4,000	.0020	.....	
5,000	.0027	0.	
6,000	.0035	.....	
7,000	.0042	.....	
8,000	.0049	.....	
9,000	.0056	.....	
10,000	.0062	0.	
11,000	.0070	.....	
12,000	.0078	.....	
13,000	.0084	.....	
14,000	.0090	.....	
15,000	.0099	0.	
16,000	.0107	.....	
17,000	.0115	.....	
18,000	.0121	.....	
19,000	.0129	.....	
20,000	.0135	.0002	
21,000	.0144	.....	
22,000	.0151	.....	
23,000	.0160	.....	
24,000	.0171	.....	
25,000	.0181	.0010	
26,000	.0196	.....	
27,000	.0208	.....	
28,000	.0226	.....	
29,000	.0247	.....	
30,000	.0271	.0060	
31,000	.0300	.....	
32,000	.0342	.....	
33,000	.0386	.....	
34,000	.0440	.....	
35,000	.0507	.0251	
39,500	.....	.....	Ultimate strength.

Failed by triple flexure.

TABULATION OF COMPRESSION SPECIMENS, BRONZE CAST AT WATERTOWN ARSENAL FOUNDRY.

No. 2 BRONZE.

No. of test.	Marks.	Treatment.	Compressive strength per square inch.	Manner of failure.
			Pounds.	
1216	D2	Dry-sand casting	18,200	By triple flexure.
1217	G2	Green-sand casting	18,500	Do.
1218	C2	Chill casting	25,900	Do.

No. 3 BRONZE.

1219	D3	Dry-sand casting	30,200	By triple flexure.
1220	G3	Green-sand casting	31,100	Do.
1221	C3	Chill casting	36,400	Do.

No. 4 BRONZE.

1222	D4	Dry-sand casting	31,300	By triple flexure.
1223	G4	Green-sand casting	33,700	Do.
1224	C4	Chill casting	39,500	Do.

HARDENED STEEL BALLS,

ON TRACK PLATES OF DIFFERENT METALS.

TESTS OF HARDENED STEEL BALLS ON TRACK PLATES OF DIFFERENT METALS.

Pressures applied to the balls placed between ground track plates. Balls spaced 1″ apart.

Diameter of balls.	Number of balls.	Kind of track plates.	Applied loads.		Diameter across each indentation in track plate.
			Total.	Per ball.	
Inches.			*Pounds.*	*Pounds.*	*Inch.*
3	3	No. 3 steel, oil tempered and annealed	6,000	2,000	0.12
3	3	.....do	9,000	3,000	.14
2	3	.....do	6,000	2,000	.09
2	3	.....do	9,000	3,000	.12
3	3	Tool steel	6,000	2,000	.10
3	3	.....do	9,000	3,000	.12
2	3	.....do	6,000	2,000	.10
2	3	.....do	9,000	3,000	.12
3	3	Cast iron No. 2	6,000	2,000	.12
3	3	.....do	9,000	3,000	.14
2	3	.....do	6,000	2,000	.12
2	3	.....do	9,000	3,000	.14
3	3	Manganese steel	6,000	2,000	.11
3	3	.....do	9,000	3,000	.13
2	3	.....do	6,000	2,000	.10
2	3	.....do	9,000	3,000	.15

TESTS OF HARDENED STEEL BALLS ON TRACK PLATE OF NO. 3 STEEL, OIL TEMPERED AND ANNEALED.

Seat on track plate grooved to a radius of 3″.

Diameter of balls.	Number of balls.	Applied loads.		Diameter across each indentation in track plate.
		Total.	Per ball.	
Inches.		*Pounds.*	*Pounds.*	
3	3	6,000	2,000	Indentation perceptible with each load. Under 6,000 pounds (2,000 pounds per ball) the indented surface measured about ″.10 × ″.16.
3	3	9,000	3,000	At 3,000 pounds pressure per ball the disturbed metal measured about ″.13 × ″.18.
2	3	6,000	2,000	Indentation, ″.10 × ″.13.
2	3	9,000	3,000	Indentation, about ″.13 × ″.15.
2	1	1,500	1,500	Indentation, ″.08 × ″.11.
2	1	1,000	1,000	Indentation, ″.07 × ″.09.
2	1	500	500	Indentation, ″.04 × ″.05.
2	1	300	300	Indentation faintly perceptible.
2	1	400	400	Do.
2	1	500	500	Indentation, ″.04 × ″.05.
2	1	600	600	Indentation, about ″.04 × ″.05.

SERIES OF LOADINGS ON FLAT SURFACE OF TRACK PLATE, WITH ONE 2-INCH BALL.

Applied loads per ball.	Diameter across indentation in track plate.
Pounds.	*Inch.*
200	Imperceptible.
300	Perceptible.
400	Do.
500	0.04
600	.06
700	.06
800	.07
900	.08
1,000	.09
1,200	.09
1,400	.10
1,600	.10
1,800	.10
2,000	.11
2,200	.11
2,400	.12
2,600	.12
2,800	.12
3,000	.12
3,500	.14
4,000	.15
4,500	.15
5,000	.16

RESULTS OF LOADING SAME TRACK PLATE AS ABOVE, WITH BALLS OF DIFFERENT DIAMETERS.

[Tests made by loading balls one at a time.]

Applied loads.	Diameter across indentation with ball of—	
	3" diameter.	1½" diameter.
Pounds.	*Inch.*	*Inch.*
100	Imperceptible....	Imperceptible.
200	.....do.....	Do.
300	.....do.....	Perceptible.
400	Perceptible.....	Do.
500	.....do.....	Do.
600	.....do.....	Do.
700	.....do.....	Do.
800	.....do.....	0.05
900	.....do.....	.05
1,000	0.04	.06
1,100	.04	
1,200	.08	.07
1,400	.09	.08
1,600	.10	.09
1,800	.11	.10
2,000	.11	.10
2,200	.12	
2,400	.12	.11
2,600	.13	
2,800	.13	.12
3,000	.14	.12
3,500	.14	.13
4,000	.15	.13
4,500	.16	.14
5,000	.17	.14
Same on grooved surface of 3" radius of curvature.		
500	Imperceptible.	
1,000	Barely perceptible.	
1,500	.08 × .13	
2,000	.10 × .15	
3,000	.12 × .17	
4,000	.13 × .20	
5,000	.14 × .23	

COPPER CYLINDERS FOR PRESSURE GAUGES.

Mean compression of 10 cylinders from Frankford Arsenal. Metal purchased May, 1901. Metal annealed April 15, 1905. Table for use with crusher gauge one-thirtieth square inch area. Mean dimensions of cylinders: Length, 0".5002; diameter, 0".2057.

Load per square inch on one-thirtieth square inch.	Total compressions.											Mean corrected sets.
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	Mean.	
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*
3,000	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
6,000	.0002	.0002	.0003	.0003	.0001	.0001	.0005	.0002	.0004	.0004	.0003	.0001
9,000	.0008	.0009	.0016	.0015	.0002	.0009	.0011	.0007	.0010	.0014	.0010	.0005
10,000	.0018	.0015	.0021	.0024	.0003	.0020	.0020	.0010	.0014	.0027	.0017	.0011
11,000	.0032	.0026	.0033	.0044	.0008	.0036	.0033	.0020	.0026	.0043	.0030	.0024
12,000	.0049	.0044	.0050	.0062	.0027	.0050	.0047	.0037	.0039	.0052	.0046	.0039
13,000	.0063	.0055	.0070	.0074	.0041	.0071	.0064	.0054	.0049	.0069	.0061	.0053
14,000	.0077	.0077	.0086	.0089	.0060	.0082	.0080	.0067	.0067	.0089	.0077	.0068
15,000	.0089	.0091	.0103	.0109	.0077	.0105	.0104	.0083	.0080	.0100	.0094	.0084
16,000	.0110	.0107	.0120	.0128	.0090	.0120	.0118	.0097	.0096	.0119	.0111	.0100
17,000	.0125	.0125	.0139	.0145	.0109	.0138	.0133	.0115	.0116	.0138	.0128	.0117
18,000	.0143	.0144	.0156	.0162	.0125	.0155	.0152	.0135	.0134	.0158	.0146	.0135
19,000	.0161	.0162	.0177	.0187	.0147	.0170	.0170	.0151	.0153	.0179	.0166	.0155
20,000	.0179	.0184	.0197	.0201	.0165	.0189	.0197	.0170	.0170	.0193	.0185	.0174
21,000	.0202	.0200	.0219	.0225	.0184	.0214	.0211	.0190	.0192	.0214	.0205	.0194
22,000	.0218	.0220	.0235	.0245	.0205	.0230	.0229	.0209	.0208	.0235	.0223	.0212
23,000	.0237	.0240	.0252	.0266	.0222	.0253	.0256	.0227	.0230	.0252	.0244	.0233
24,000	.0260	.0259	.0274	.0291	.0244	.0274	.0279	.0247	.0249	.0276	.0265	.0253
25,000	.0280	.0281	.0293	.0312	.0262	.0290	.0296	.0270	.0270	.0297	.0285	.0273
26,000	.0300	.0301	.0314	.0330	.0284	.0310	.0315	.0289	.0287	.0318	.0305	.0293
27,000	.0319	.0323	.0340	.0352	.0310	.0335	.0336	.0308	.0309	.0336	.0327	.0315
28,000	.0342	.0344	.0363	.0371	.0328	.0354	.0360	.0335	.0330	.0357	.0348	.0336
29,000	.0363	.0365	.0381	.0395	.0350	.0376	.0386	.0352	.0358	.0391	.0372	.0360
30,000	.0387	.0389	.0406	.0415	.0379	.0405	.0400	.0372	.0375	.0402	.0393	.0381
31,000	.0405	.0410	.0425	.0444	.0400	.0423	.0427	.0398	.0398	.0429	.0416	.0404
32,000	.0429	.0437	.0444	.0462	.0423	.0452	.0449	.0416	.0423	.0450	.0439	.0427
33,000	.0450	.0452	.0470	.0486	.0443	.0471	.0469	.0440	.0444	.0473	.0460	.0448
34,000	.0476	.0478	.0495	.0506	.0466	.0493	.0493	.0464	.0465	.0505	.0484	.0472
35,000	.0497	.0500	.0520	.0538	.0482	.0524	.0517	.0484	.0490	.0521	.0507	.0493
36,000	.0519	.0523	.0539	.0553	.0512	.0543	.0544	.0507	.0510	.0542	.0529	.0515
37,000	.0541	.0549	.0557	.0581	.0536	.0573	.0567	.0527	.0540	.0567	.0554	.0540
38,000	.0565	.0570	.0590	.0604	.0555	.0605	.0589	.0556	.0568	.0595	.0580	.0566
39,000	.0587	.0589	.0611	.0625	.0579	.0622	.0615	.0580	.0588	.0617	.0601	.0587
40,000	.0611	.0615	.0634	.0655	.0603	.0641	.0642	.0606	.0609	.0642	.0626	.0612
41,000	.0634	.0634	.0657	.0675	.0637	.0675	.0667	.0633	.0630	.0668	.0651	.0637
42,000	.0656	.0663	.0675	.0710	.0658	.0698	.0690	.0666	.0658	.0690	.0676	.0662
43,000	.0685	.0688	.0710	.0731	.0682	.0723	.0719	.0678	.0685	.0722	.0702	.0688
44,000	.0721	.0709	.0730	.0758	.0705	.0746	.0739	.0701	.0710	.0742	.0726	.0712
45,000	.0734	.0740	.0755	.0779	.0729	.0763	.0765	.0728	.0733	.0768	.0749	.0735
46,000	.0748	.0760	.0774	.0806	.0757	.0789	.0793	.0750	.0758	.0790	.0773	.0759
47,000	.0778	.0789	.0806	.0826	.0789	.0816	.0819	.0788	.0789	.0825	.0803	.0789
48,000	.0808	.0815	.0837	.0858	.0805	.0840	.0840	.0811	.0817	.0841	.0827	.0813
49,000	.0839	.0838	.0856	.0881	.0829	.0864	.0868	.0829	.0837	.0873	.0851	.0837
50,000	.0862	.0865	.0886	.0900	.0858	.0890	.0898	.0850	.0868	.0894	.0877	.0863
51,000	.0883	.0885	.0912	.0931	.0890	.0935	.0928	.0871	.0881	.0920	.0904	.0890
52,000	.0901	.0921	.0941	.0972	.0909	.0963	.0949	.0905	.0921	.0951	.0934	.0920
53,000	.0937	.0945	.0961	.0988	.0946	.0976	.0979	.0930	.0950	.0972	.0959	.0945
54,000	.0966	.0970	.1002	.1012	.0970	.0998	.1007	.0964	.0972	.1002	.0986	.0972
55,000	.0982	.0990	.1026	.1043	.0994	.1043	.1031	.0997	.1001	.1027	.1013	.0999
56,000	.1005	.1025	.1058	.1075	.1018	.1066	.1056	.1015	.1023	.1056	.1040	.1027
57,000	.1023	.1044	.1080	.1098	.1045	.1090	.1079	.1043	.1059	.1081	.1064	.1051
58,000	.1054	.1078	.1122	.1130	.1075	.1128	.1111	.1068	.1090	.1123	.1098	.1085
59,000	.1075	.1104	.1146	.1170	.1100	.1151	.1141	.1096	.1118	.1146	.1125	.1112
60,000	.1112	.1134	.1174	.1202	.1128	.1178	.1169	.1122	.1144	.1167	.1153	.1140
62,000	.1168	.1194	.1245	.1258	.1185	.1223	.1230	.1184	.1210	.1225	.1212	.1199
64,000	.1220	.1236	.1325	.1328	.1230	.1270	.1274	.1239	.1279	.1276	.1267	.1254
66,000	.1274	.1281	.1428	.1415	.1287	.1310	.1329	.1290	.1384	.1337	.1334	.1322
68,000	.1325	.1340	.1508	.1490	.1345	.1385	.1381	.1334	.1465	.1378	.1395	.1382
70,000	.1377	.1390	.1638	.1595	.1391	.1429	.1435	.1386	.1565	.1422	.1463	.1451

Load per square inch on one-thirtieth square inch.	Total compressions.											Mean corrected sets.
	1.	2.	3.	4.	5	6.	7.	8.	9.	10.	Mean.	
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*
72,000	0.1429	0.1442	0.1758	0.1700	0.1457	0.1480	0.1484	0.1442	0.1690	0.1476	0.1450	[a].1438
74,000	.1484	.1492	.1920	.1782	.1502	.1546	.1529	.1500	.1769	.1520	.1501	[a].1489
76,000	.1538	.1530	.2053	.1900	.1560	.1595	.1579	.1555	.1978	.1560	.1552	[a].1540
78,000	.1588	.1576	.2180	.2017	.1605	.1681	.1650	.1625	.2115	.1631	.1608	[a].1596
80,000	.1641	.1626	.2285	.2150	.1662	.1791	.1730	.1708	.2228	.1685	.1673	[a].1661
82,000	.1690	.1676	.2400	.2232	.1704	.1855	.1789	.1773	.2320	.1728	.1726	[a].1714
84,000	.1747	.1724	.....	.2324	.1765	.1936	.1865	.1860	.2400	.1785	.1792	[a].1782
86,000	.1800	.1770	.....	.2382	.1814	.2025	.1942	.1946	.2467	.1840	.1854	[a].1844
88,000	.1848	.1824	.....	.2458	.1855	.2090	.2010	.2016	.....	.1909	.1911	[a].1901
90,000	.1898	.1880	.....	.....	.1902	.2170	.2080	.2090	.....	.1956	.1970	[a].1960
92,000	.1944	.1939	.....	.....	.1950	.2250	.2160	.2165	.....	.2017	.2032	[a].2023
94,000	.1986	.1989	.....	.....	.1992	.2300	.2225	.2246	.....	.2080	.2088	[a].2079
96,000	.2033	.2046	.....	.....	.2040	.2360	.2282	.2305	.....	.2138	.2141	[a].2132
98,000	.2078	.2093	.....	.....	.2090	.2422	.2340	.2367	.....	.2192	.2194	[a].2185
100,000	.2129	.2140	.....	.....	.2138	.2456	.2390	.2417	.....	.2242	.2243	[a].2234

[a] From 72,000 pounds to 100,000 pounds, inclusive, the mean of 5 cylinders only is given—Nos. 1, 2, 5, 7, and 8.

Nos. 3, 4, and 9 took an oblique direction at 64,000 pounds.

Nos. 6 and 10 took an oblique direction at 68,000 pounds.

Nos. 2, 7, and 8 were slightly oblique after 100,000 pounds.

Initial compression of 15 series of coppers from the same lot as those used in the preceding tarage table.

The cylinders were loaded once each by a load immediately advanced to the prescribed limit and then promptly released.

[Cylinders loaded with 1,000 pounds=30,000 pounds per square inch.]

Initial height.	Final height.	Difference.
Inch.	*Inch.*	*Inch.*
.5002	.4642	.0360
.5003	.4635	.0368
.5004	.4637	.0367
.5004	.4625	.0379
.5001	.4621	.0380
Mean difference.....		.0371

[Cylinders loaded with 1,167 pounds=35,000 pounds per square inch.]

.5002	.4506	.0496
.5003	.4505	.0498
.5002	.4505	.0497
.5002	.4513	.0489
.5003	.4522	.0481
Mean difference.....		.0492

[Cylinders loaded with 1,333 pounds=40,000 pounds per square inch.]

.5007	.4397	.0610
.5005	.4415	.0590
.5007	.4407	.0600
.5005	.4394	.0611
.5003	.4391	.0612
Mean difference.....		.0605

[Cylinders loaded with 1,500 pounds=45,000 pounds per square inch.]

.5004	.4285	0719
.5004	.4300	0704
.5003	.4304	0699
.5003	.4283	0720
.5006	.4290	.0712
Mean difference.....		.0711

[Cylinders loaded with 1,667 pounds=50,000 pounds per square inch.]

.5002	.4165	.0836
.5004	.4145	.0859
.5004	.4136	.0868
.5003	.4165	.0838
.5004	.4186	.0818
Mean difference.....		.0844

[Cylinders loaded with 1,833 pounds=55,000 pounds per square inch.]

.5004	.4074	.0930
.5003	.4044	.0959
.5004	.4042	.0962
.5006	.4016	.0980
.5007	.4056	.0951
Mean difference.....		.0956

[Cylinders loaded with 2,000 pounds=60,000 pounds per square inch.]

Initial height	Final height.	Difference.
Inch.	*Inch.*	*Inch.*
.5003	.3890	.1113
.5005	.3926	.1079
.5002	.3896	.1106
.5004	.3912	.1092
.5005	.3902	.1103
Mean difference.....		.1099

[Cylinders loaded with 2,167 pounds=65,000 pounds per square inch.]

.5004	.3754	.1250
.5004	.3762	.1242
.5003	.3800	.1203
.5003	.3766	.1237
.5004	.3742	.1262
Mean difference.....		.1239

[Cylinders loaded with 2,333 pounds=70,000 pounds per square inch.]

.5003	.3620	.1383
.5004	.3641	.1363
.5005	.3643	.1362
.5001	.3629	.1372
.5003	.3623	.1380
Mean difference.....		.1372

[Cylinders loaded with 2,500 pounds=75,000 pounds per square inch.]

.5002	.3483	.1519
.5003	.3487	.1516
.5004	.3529	.1475
.5003	.3513	.1490
.5004	.3519	.1485
Mean difference.....		.1497

[Cylinders loaded with 2,667 pounds=80,000 pounds per square inch.]

.5005	.3345	.1660
.5004	.3432	.1572
.5003	.3386	.1617
.5005	.3394	.1611
.5001	.3404	.1597
Mean difference.....		.1611

[Cylinders loaded with 2,833 pounds=85,000 pounds per square inch.]

.5003	.3291	.1712
.5006	.3244	.1762
.5005	.3243	.1762
.5003	.3267	.1736
.5003	.3266	.1737
Mean difference.....		.1742

[Cylinders loaded with 3,000 pounds=90,000 pounds per square inch.]

Initial height.	Final height.	Difference.
Inch.	*Inch.*	*Inch.*
.5003	.3142	.1861
.5004	.3136	.1868
.5004	.3127	.1877
.5003	.3163	.1840
.5003	.3123	.1880
Mean difference.....		.1865

[Cylinders loaded with 3,167 pounds=95,000 pounds per square inch.]

.5004	.3026	.1978
.5004	.3034	.1970
.5002	.3063	.1939
.5002	.3022	.1980
.5003	.3066	.1937
Mean difference.....		.1961

[Cylinders loaded with 3,333 pounds=100,000 pounds per square inch.]

.5004	.2873	.2131
.5004	.2878	.2126
.5003	.2906	.2097
.5003	.2890	.2113
.5003	.2933	.2070
Mean difference.....		.2107

EXAMINATION OF COPPER CYLINDERS FOR $\frac{1}{10}$ SQUARE INCH PRESSURE GAUGE.

Lot of 100 uncompressed cylinders, and 100 which were shortened to a length of ".4555± at Frankford Arsenal.

The uncompressed coppers were from metal procured in May, 1901, and annealed April 15, 1905. Watertown Arsenal table of May 12, 1905.

The initially depressed (shortened) coppers, depressed at Frankford Arsenal, were from metal procured in May, 1901. Watertown Arsenal table of March 15, 1904.

Examination made at this time by means of dead weights of 1,000, 1,100, and 1,200 pounds, and with coppers compressed in the 100,000 pounds testing machine.

COPPERS LOADED IN THE 100,000 POUNDS TESTING MACHINE.

Applied loads.		Initially depressed coppers.						Uncompressed copper.		
Total.	On $\frac{1}{10}$ square inch gauge.	Initial.	Final.	Difference.	Initial.	Final.	Difference.	Initial.	Final.	Difference.
Pounds.	*Pounds.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*
1,000	30,000	.4555	.4551	.0004	.4555	.4549	.0006	.5002	.4622	.0380
1,100	33,000	.4551	.4546	.0005	.4549	.4537	.0012	.4622	.4545	.0077
1,200	36,000	.4546	.4483	.0063	.4537	.4462	.0075	.4545	.4481	.0064
1,300	39,000	.4483	.4414	.0069	.4462	.4376	.0086	.4481	.4402	.0079
1,400	42,000	.4414	.4301	.0113	.4376	.4304	.0072	.4402	.4321	.0081
1,500	45,000	.4301	.4210	.0091	.4304	.4214	.0090	.4321	.4236	.0085
1,600	48,000	.4210	.4123	.0087	.4214	.4121	.0093	.4236	.4162	.0074
1,700	51,000	.4123	.4026	.0097	.4121	.4044	.0077	.4162	.4076	.0086
1,800	54,000	.4026	.3932	.0094	.4044	.3949	.0095	.4076	.3978	.0098
1,900	57,000	.3932	.3842	.0090	.3949	.3863	.0086	.3978	.3903	.0075
2,000	60,000	.3842	.3750	.0092	.3862	.3768	.0095	.3903	.3808	.0095
2,100	63,000	.3750	.3654	.0096	.3768	.3868	.0084	.3808	.3716	.0092
2,200	66,000	.3654	.3566	.0088	.3684	.3593	.0091	.3716	.3641	.0071

Three cylinders were loaded in the determinations with the 100,000 pounds testing machine, two of the depressed lot, and one of the uncompressed lot. Each was loaded progressively from 30,000 to 66,000 pounds, referred to a $\frac{1}{10}$ square inch gauge. Between each successive load the cylinder was removed and measured, then the next higher load applied and remeasured as before, thus continuing until 66,000 pounds was reached.

Other coppers were loaded by means of dead weights, as outlined in the following programme:

Uncompressed coppers of tarage table of May, 1905:

Nos. 1 to 10: 1,000 lbs.=30,000 lbs.. } 10 coppers loaded in succession with each load.
1,100 lbs.=33,000 lbs.. }
1,200 lbs.=36,000 lbs.. }

Nos. 11 to 20: 1,100 lbs.=33,000 lbs.. } Do.
1,200 lbs.=36,000 lbs.. }

Nos. 21 to 30: 1,200 lbs.=36,000 lbs.. Do.

Nos. 31 to 40: 1,000 lbs.=30,000 lbs.. } 10 coppers loaded in succession with each load, twice applied.
1,100 lbs.=33,000 lbs.. }
1,200 lbs.=36,000 lbs.. }

Depressed coppers of tarage table of March, 1904 (depressed at Frankford Arsenal to height of ".4555±):

Nos. 41 to 50: 1 000 lbs.=30,000 lbs.. } 10 coppers loaded in succession with each load.
1,100 lbs.=33,000 lbs.. }
1,200 lbs.=36,000 lbs.. }

Nos. 71 to 80: 1,100 lbs.=33,000 lbs.. } Do.
1,200 lbs.=36,000 lbs.. }

Nos. 51 to 60: 1,200 lbs.=36,000 lbs.. Do.

Nos. 61 to 70: 1,000 lbs.=30,000 lbs.. } 10 coppers loaded in succession with each load, twice applied.
1,100 lbs.=33,000 lbs.. }
1,200 lbs.=36,000 lbs.. }

Nos. 81 to 83;

UNCOMPRESSED COPPERS OF TABLE OF MAY, 1905.

No.	Loaded with 1,000—30,000 pounds.			Loaded with 1,100—33,000 pounds.			Loaded with 1,200—36,000 pounds.		
	Initial.	Final.	Difference.	Initial.	Final.	Difference.	Initial.	Final.	Difference.
	Inch.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*
1	.5001	.4674	.0327	.4674	.4582	.0092	.4582	.4531	.0051
2	.5004	.4671	.0333	.4671	.4617	.0054	.4617	.4552	.0065
3	.5000	.4686	.0314	.4686	.4597	.0089	.4597	.4576	.0021
4	.4995	.4674	.0321	.4674	.4616	.0058	.4616	.4536	.0080
5	.5000	.4662	.0338	.4662	.4602	.0060	.4602	.4549	.0053
6	.5002	.4672	.0330	.4672	.4619	.0052	.4619	.4544	.0075
7	.5001	.4700	.0301	.4700	.4637	.0063	.4637	.4566	.0071
8	.5002	.4683	.0319	.4683	.4587	.0096	.4587	.4544	.0043
9	.4998	.4678	.0320	.4678	.4598	.0080	.4598	.4548	.0050
10	.5003	.4708	.0295	.4708	.4612	.0096	.4612	.4591	.0021
Means.....		.4681	.....	.....	.4607	.....	.....	.4554	.....

No.	Loaded with 1,100—33,000 pounds.			Loaded with 1,200—36,000 pounds.		
	Initial.	Final.	Difference.	Initial.	Final.	Difference.
	Inch.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*
11	.4998	.4586	.0412	.4586	.4562	.0024
12	.4994	.4621	.0373	.4621	.4560	.0061
13	.5003	.4620	.0383	.4620	.4580	.0040
14	.5005	.4603	.0402	.4603	.4552	.0051
15	.5004	.4599	.0405	.4599	.4554	.0045
16	.5001	.4603	.0398	.4603	.4556	.0047
17	.5003	.4623	.0380	.4623	.4564	.0059
18	.5005	.4611	.0394	.4611	.4577	.0034
19	.5002	.4607	.0395	.4607	.4575	.0032
20	.4989	.4591	.0398	.4591	.4534	.0057
Means.....		.4606	.....	.....	.4561	.....

No.	Loaded with 1,200—36,000 pounds.			Reloaded in 100,000 pounds testing machine with 1,200—36,000 pounds.			Again loaded, with dead weight, with 1,200—36,000 pounds.		
	Initial.	Final.	Difference.	Initial.	Final.	Difference.	Initial.	Final.	Difference.
	Inch.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*
21	.4998	.4544	.0454	.4544	.4504	.0040	.4504	.4491	.0013
22	a.5003	.4502	.0501	.4502	.4496	.0006	a.4496	.4482	.0014
23	.5006	.4557	.0449	.4557	.4504	.0053	.4504	.4488	.0016
24	a.4998	.4484	.0514	.4484	.4482	.0002	a.4482	.4458	.0024
25	.5001	.4546	.0455	.4546	.4490	.0056	.4490	.4467	.0021
26	a.5003	.4491	.0512	.4491	.4484	.0007	.4484	.4476	.0008
27	.4995	.4550	.0445	.4550	.4486	.0064	.4486	.4471	.0015
28	a.5004	.4514	.0490	.4514	.4502	.0012	.4502	.4492	.0010
29	.5003	.4542	.0451	.4542	.4486	.0056	.4486	.4475	.0011
30	a.5001	.4486	.0515	.4486	.4483	.0003	.4483	.4472	.0011
Means.....		.4522	.....	.....	.4492	.....	.....	.4477	.....

aHousing jarred to neutralize friction.

Mean of five not jarred, ".4548.
Mean of five (a) jarred, ".4496.

UNCOMPRESSED COPPERS OF TABLE OF MAY, 1905—Continued.

No.	Nos. 21 and 23 again loaded in 100,000 pounds testing machine with 1,200—36,000 pounds.		
	Initial.	Final.	Difference.
	Inch.	*Inch.*	*Inch.*
21	.4491	.4490	.0001
23	.4488	.4486	.0002

No.	Loaded with 1,000—30,000 pounds.			Loaded with 1,100—33,000 pounds.			Loaded with 1,200—36,000 pounds.		
	Initial.	Final.	Difference.	Initial.	Final.	Difference.	Initial.	Final.	Difference.
	Inch.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*
31	.5002	.4713	.0289	.4706	.4657	.0049	.4638	.4576	.0062
		.4706	.0007		.4638	.0019		.4565	.0011
32	.5002	.4692	.0310	.4685	.4626	.0059	.4610	.4570	.0040
		.4685	.0007		.4610	.0016		.4549	.0021
33	.5006	.4678	.0328	.4673	.4622	.0051	.4604	.4549	.0055
		.4673	.0005		.4604	.0018		.4535	.0014
34	.4999	.4677	.0322	.4676	.4621	.0055	.4611	.4569	.0042
		.4676	.0001		.4611	.0010		.4548	.0021
35	.5003	.4671	.0332	.4667	.4624	.0043	.4600	.4542	.0058
		.4667	.0004		.4600	.0024		.4526	.0016
36	.5003	.4676	.0327	.4673	.4621	.0052	.4605	.4566	.0039
		.4673	.0003		.4605	.0016		.4552	.0014
37	.5003	.4692	.0311	.4683	.4622	.0061	.4603	.4544	.0059
		.4683	.0010		.4603	.0019		.4536	.0008
38	.5002	.4684	.0318	.4683	.4623	.0060	.4606	.4566	.0040
		.4683	.0001		.4606	.0017		.4546	.0020
39	.4994	.4690	.0304	.4682	.4614	.0068	.4611	.4533	.0078
		.4682	.0008		.4611	.0003		.4519	.0014
40	.4999	.4718	.0281	.4716	.4653	.0063	.4642	.4582	.0060
		.4716	.0002		.4642	.0011		.4568	.0014

Cylinders which were Initially Depressed at Frankford Arsenal.

[Table of March, 1904.]

No.	Loaded with 1,000—30,000 pounds.			Loaded with 1,100—33,000 pounds.			Loaded with 1,200—36,000 pounds.		
	Initial.	Final.	Difference.	Initial.	Final.	Difference.	Initial.	Final.	Difference.
	Inch.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*
41	.4556	.4553	.0003	.4553	.4548	.0005	.4548	.4534	.0014
42	.4556	.4552	.0004	.4552	.4543	.0009	.4543	.4538	.0005
43	.4560	.4552	.0008	.4552	.4544	.0008	.4544	.4533	.0011
44	.4556	.4552	.0004	.4552	.4546	.0006	.4546	.4537	.0009
45	.4554	.4551	.0003	.4551	.4547	.0004	.4547	.4536	.0011
46	.4553	.4551	.0002	.4551	.4535	.0016	.4535	.4524	.0011
47	.4554	.4549	.0005	.4549	.4546	.0003	.4546	.4524	.0022
48	.4556	.4555	.0001	.4555	.4553	.0002	.4553	.4534	.0019
49	.4561	.4553	.0008	.4553	.4552	.0001	.4552	.4542	.0010
50	.4555	.4554	.0001	.4554	.4547	.0007	.4547	.4537	.0010
Mean					.4546				

No.	Loaded with 1,100—33,000 pounds.			Loaded with 1,200—36,000 pounds.		
	Initial.	Final.	Difference.	Initial.	Final.	Difference.
	Inch.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*
71	.4555	.4547	.0008	.4547	.4524	.0023
72	.4555	.4543	.0012	.4543	.4523	.0020
73	.4557	.4544	.0013	.4544	.4532	.0012
74	.4555	.4548	.0007	.4548	.4525	.0023
75	.4555	.4544	.0011	.4544	.4528	.0016
76	.4556	.4546	.0010	.4546	.4533	.0013
77	.4556	.4549	.0007	.4549	.4533	.0016
78	.4553	.4536	.0017	.4536	.4512	.0024
79	.4555	.4546	.0009	.4546	.4526	.0020
80	.4556	.4537	.0019	.4537	.4527	.0010

No.	Loaded with 1,200—36,000 pounds.			Reloaded in 100,000 pounds testing machine with 1,200—36,000 pounds.			Again loaded, with dead weight, with 1,200—36,000 pounds.		
	Initial.	Final.	Difference.	Initial.	Final.	Difference.	Initial.	Final.	Difference.
	Inch.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*
51	[a] .4555	.4516	.0039	.4516	.4475	.0041	.4475	.4464	.0011
52	[a] .4563	.4472	.0091	.4472	.4452	.0020	.4452	.4438	.0014
53	.4554	.4538	.0016	.4538	.4463	.0075	.4463	[c] .4452	.0011
54	[b] .4555	.4542	.0013	.4542	.4476	.0066	.4476	.4467	.0009
55	[a] .4556	.4472	.0084	.4472	.4456	.0016	.4456	.4450	.0006
56	.4556	.4525	.0031	.4525	.4444	.0081	.4444	.4436	.0008
57	[a] .4555	.4503	.0052	.4503	.4452	.0051	.4452	[d] .4432	.0020
58	.4556	.4527	.0029	.4527	.4457	.0070	.4457	.4446	.0011
59	[a] .4556	.4486	.0070	.4486	.4478	.0008	.4478	.4465	.0013
60	.4554	.4525	.0029	.4525	.4455	.0070	.4455	.4447	.0008
Means					.4461			.4450	

[a] Housing jarred to neutralize friction.
[b] Sustained load five minutes, but not jarred.
[c] Reloaded in 100,000 pounds testing machine, ".4451; reloaded with dead weight, ".4438.
[d] Reloaded in 100,000 pounds testing machine, ".4427.

CYLINDERS WHICH WERE INITIALLY DEPRESSED AT FRANKFORD ARSENAL—Cont'd.

No.	Loaded with 1,000—30,000 pounds.			Loaded with 1,100—33,000 pounds.			Loaded with 1,200—36,000 pounds.		
	Initial.	Final.	Difference.	Initial.	Final.	Difference.	Initial.	Final.	Difference.
	Inch.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*
61	.4560	.4554	.0006	.4553	.4552	.0001	.4547	.4536	.0011
		.4553	.0001		.4547	.0005		.4533	.0003
62	.4554	.4552	.0002	.4551	.4543	.0008	.4542	.4522	.0020
		.4551	.0001		.4542	.0001		.4517	.0005
63	.4554	.4551	.0003	.4550	.4548	.0002	.4543	.4526	.0017
		.4550	.0001		.4543	.0005		.4516	.0010
64	.4553	.4546	.0007	.4546	.4538	.0008	.4534	.4516	.0018
		.4546	0.		.4534	.0004		.4496	.0021
65	.4557	.4552	.0005	.4550	.4538	.0012	.4537	.4514	.0023
		.4550	.0002		.4537	.0001		.4506	.0008
66	.4559	.4553	.0006	.4550	.4548	.0002	.4548	.4534	.0014
		.4550	.0003		.4548	0.		.4522	.0012
67	.4554	.4552	.0002	.4549	.4533	.0016	.4529	.4514	.0015
		.4549	.0003		.4529	.0004		.4501	.0013
68	.4554	.4550	.0004	.4550	.4547	.0003	.4545	.4532	.0013
		.4550	0.		4545	.0002		.4520	.0012
69	.4556	.4552	.0004	.4547	.4544	.0003	.4545	.4527	.0018
		.4547	.0005		.4543	.0001		.4504	.0023
70	.4559	.4554	.0005	.4553	.4544	.0009	.4543	.4540	.0003
		.4553	.0001		.4543	.0001		.4526	.0014
Mean, first loading								.4526	
Mean, second loading								.4514	

SURPLUS COPPERS LEFT OVER AFTER MAKING TARAGE TABLE OF MAY, 1905.

[Metal of May, 1901; annealed April 15, 1905.]

No.	Loaded in 100,000 pounds testing machine with 1,200—36,000 pounds.			Reloaded with dead weight at 1,200—36,000 pounds.			Again loaded with dead weight at 1,200—36,000 pounds.		
	Initial.	Final.	Difference.	Initial.	Final.	Difference.	Initial.	Final.	Difference.
	Inch.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*
81	.5003	.4463	.0540	.4463	.4452	.0011	.4452	.4449	.0003
82	.5004	.4487	.0517	.4487	.4476	.0011	.4476	.4473	.0003
83	.5003	.4504	.0499	.4504	.4487	.0017	.4487	.4445	.0002
Means	.5003	.4485	.0518						

Mean compression of 10 cylinders from Frankford Arsenal. Metal purchased May, 1901. Metal annealed February 6, 1906. Table for use with crusher gauge, one-thirtieth square inch area. Mean dimensions of cylinders: Length, 0".5005; diameter, 0".2055.

Load per square inch on crusher gauge one-thirtieth square inch area.	Total compressions.											Mean corrected sets.
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	Mean.	
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch*	*Inch.*
3,000	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
6,000	.0006	.0004	.0004	.0008	.0004	.0004	.0005	.0006	.0005	.0005	.0005	.0003
9,000	.0021	.0014	.0016	.0052	.0028	.0025	.0024	.0020	.0025	.0020	.0025	.0020
10,000	.0033	.0023	.0027	.0066	.0037	.0040	.0038	.0035	.0049	.0036	.0038	.0032
11,000	.0044	.0040	.0044	.0084	.0049	.0056	.0050	.0059	.0063	.0051	.0054	.0048
12,000	.0061	.0056	.0059	.0103	.0068	.0078	.0070	.0074	.0081	.0069	.0072	.0065
13,000	.0078	.0072	.0075	.0112	.0081	.0089	.0083	.0090	.0097	.0086	.0086	.0078
14,000	.0094	.0090	.0090	.0118	.0100	.0108	.0102	.0098	.0116	.0102	.0102	.0093
15,000	.0112	.0110	.0108	.0143	.0136	.0126	.0120	.0123	.0133	.0123	.0123	.0113
16,000	.0130	.0122	.0127	.0154	.0147	.0144	.0139	.0133	.0149	.0137	.0138	.0127
17,000	.0144	.0141	.0141	.0185	.0151	.0160	.0152	.0164	.0175	.0155	.0157	.0146
18,000	.0165	.0158	.0163	.0197	.0169	.0176	.0174	.0176	.0193	.0178	.0175	.0164
19,000	.0180	.0176	.0180	.0221	.0186	.0201	.0191	.0189	.0213	.0199	.0194	.0183
20,000	.0202	.0198	.0198	.0238	.0222	.0219	.0215	.0210	.0234	.0221	.0216	.0205
21,000	.0224	.0217	.0219	.0261	.0233	.0239	.0235	.0233	.0251	.0241	.0235	.0224
22,000	.0242	.0234	.0235	.0278	.0248	.0258	.0251	.0251	.0269	.0255	.0252	.0241
23,000	.0272	.0253	.0258	.0302	.0270	.0279	.0278	.0273	.0294	.0284	.0276	.0265
24,000	.0285	.0279	.0280	.0321	.0296	.0298	.0293	.0290	.0315	.0296	.0295	.0283
25,000	.0306	.0297	.0300	.0339	.0308	.0319	.0315	.0314	.0336	.0316	.0315	.0303
26,000	.0328	.0316	.0320	.0363	.0337	.0341	.0342	.0335	.0358	.0340	.0338	.0326
27,000	.0348	.0340	.0344	.0388	.0356	.0364	.0355	.0348	.0376	.0379	.0360	.0348
28,000	.0372	.0356	.0360	.0407	.0390	.0388	.0377	.0371	.0398	.0403	.0382	.0370
29,000	.0389	.0384	.0381	.0426	.0408	.0408	.0400	.0398	.0422	.0426	.0404	.0392
30,000	.0413	.0404	.0405	.0452	.0414	.0428	.0423	.0425	.0444	.0435	.0424	.0412
31,000	.0434	.0427	.0429	.0473	.0442	.0453	.0444	.0442	.0466	.0475	.0449	.0437
32,000	.0448	.0448	.0453	.0498	.0465	.0474	.0466	.0481	.0494	.0494	.0472	.0460
33,000	.0484	.0471	.0477	.0517	.0500	.0500	.0490	.0490	.0517	.0519	.0497	.0485
34,000	.0500	.0494	.0494	.0540	.0510	.0525	.0510	.0510	.0530	.0523	.0514	.0502
35,000	.0524	.0518	.0513	.0566	.0534	.0554	.0534	.0530	.0563	.0572	.0541	.0527
36,000	.0542	.0545	.0547	.0589	.0574	.0577	.0560	.0554	.0584	.0595	.0567	.0553
37,000	.0571	.0560	.0557	.0611	.0596	.0588	.0581	.0579	.0609	.0607	.0586	.0572
38,000	.0584	.0588	.0589	.0640	.0623	.0616	.0604	.0606	.0634	.0638	.0612	.0598
39,000	.0625	.0610	.0611	.0660	.0636	.0650	.0630	.0629	.0655	.0654	.0636	.0622
40,000	.0638	.0636	.0628	.0680	.0648	.0681	.0655	.0645	.0677	.0683	.0657	.0643
41,000	.0664	.0658	.0657	.0711	.0675	.0709	.0680	.0682	.0704	.0690	.0683	.0669
42,000	.0690	.0682	.0684	.0731	.0705	.0742	.0701	.0704	.0736	.0715	.0709	.0695
43,000	.0719	.0704	.0703	.0758	.0729	.0758	.0725	.0721	.0757	.0737	.0731	.0717
44,000	.0739	.0737	.0728	.0791	.0759	.0795	.0750	.0747	.0785	.0780	.0761	.0747
45,000	.0760	.0768	.0748	.0807	.0779	.0811	.0786	.0779	.0813	.0815	.0787	.0773
46,000	.0791	.0794	.0779	.0833	.0807	.0828	.0807	.0803	.0840	.0831	.0811	.0797
47,000	.0818	.0823	.0803	.0867	.0833	.0839	.0826	.0826	.0860	.0856	.0835	.0821
48,000	.0845	.0848	.0826	.0887	.0858	.0868	.0858	.0849	.0889	.0870	.0860	.0846
49,000	.0877	.0854	.0859	.0905	.0884	.0898	.0880	.0890	.0908	.0884	.0884	.0870
50,000	.0897	.0884	.0886	.0938	.0917	.0928	.0923	.0908	.0947	.0913	.0914	.0900
51,000	.0922	.0913	.0900	.0967	.0939	.0950	.0934	.0930	.0969	.0950	.0937	.0923
52,000	.0948	.0940	.0933	.0989	.0966	.0979	.0960	.0958	.0993	.0975	.0964	.0950
53,000	.0969	.0973	.0968	.1019	.0994	.1013	.0985	.0984	.1028	.0999	.0993	.0979
54,000	.1002	.0986	.0992	.1049	.1022	.1040	.1016	.1013	.1054	.1036	.1021	.1007
55,000	.1022	.1014	.1011	.1070	.1070	.1064	.1039	.1037	.1074	.1053	.1045	.1031
56,000	.1048	.1038	.1039	.1100	.1093	.1088	.1078	.1064	.1110	.1076	.1073	.1060
57,000	.1084	.1060	.1064	.1124	.1102	.1120	.1107	.1086	.1134	.1114	.1100	.1087
58,000	.1103	.1081	.1093	.1150	.1115	.1140	.1123	.1120	.1156	.1138	.1122	.1109
59,000	.1129	.1114	.1117	.1178	.1154	.1179	.1152	.1134	.1184	.1159	.1150	.1137
60,000	.1148	.1135	.1160	.1195	.1181	.1205	.1178	.1162	.1214	.1188	.1177	.1164
62,000	.1215	.1192	.1204	.1263	.1231	.1254	.1236	.1230	.1271	.1245	.1234	.1221
64,000	.1256	.1244	.1260	.1315	.1295	.1317	.1283	.1273	.1322	.1321	.1289	.1276
66,000	.1304	.1284	.1308	.1360	.1330	.1352	.1352	.1323	.1375	.1350	.1334	.1321
68,000	.1359	.1344	.1359	.1410	.1400	.1400	.1393	.1388	.1430	.1395	.1388	.1376
70,000	.1404	.1390	.1409	.1465	.1442	.1468	.1449	.1424	.1476	.1455	.1438	.1426
72,000	.1474	.1440	.1460	.1512	.1493	.1500	.1503	.1475	.1524	.1493	.1487	.1475
74,000	.1515	.1492	.1518	.1563	.1542	.1565	.1547	.1528	.1590	.1548	.1541	.1529
76,000	.1569	.1539	.1555	.1619	.1606	.1612	.1608	.1587	.1625	.1598	.1592	.1580
78,000	.1629	.1584	.1606	.1660	.1660	.1665	.1655	.1625	.1685	.1652	.1642	.1630
80,000	.1665	.1639	.1667	.1718	.1717	.1715	.1704	.1685	.1733	.1698	.1694	.1682
82,000	.1721	.1696	.1715	.1766	.1756	.1760	.1762	.1725	.1784	.1749	.1742	.1730

Load per square inch on crusher gauge one-thirtieth square inch area.	Total compressions.											Mean corrected sets.
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	Mean.	
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*
84,000	0.1768	0.1731	0.1760	0.1818	0.1798	0.1822	0.1806	0.1784	0.1829	0.1793	0.1791	0.1781
86,000	.1815	.1789	.1814	.1875	.1851	.1875	.1854	.1827	.1880	.1852	.1843	.1833
88,000	.1864	.1830	.1859	.1912	.1896	.1910	.1900	.1868	.1921	.1894	.1885	.1875
90,000	.1908	.1875	.1900	.1956	.1941	.1974	.1946	.1913	.1974	.1941	.1933	.1923
92,000	.1956	.1924	.1948	.2009	.1988	.2009	.1996	.1963	.2020	.1991	.1980	.1971
94,000	.2003	.1968	.2003	.2054	.2036	.2058	.2043	.2004	.2058	.2030	.2026	.2017
96,000	.2046	.2014	.2044	.2098	.2082	.2095	.2084	.2054	.2108	.2079	.2070	.2061
98,000	.2095	.2059	.2085	.2145	.2130	.2146	.2129	.2102	.2152	.2115	.2116	.2107
100,000	.2129	.2104	.2134	.2192	.2176	.2185	.2175	.2138	.2193	.2162	.2159	.2150

Groups of five cylinders each were initially compressed with loads of from 35,000 to 60,000 pounds each.

The cylinders were loaded once each by a load immediately advanced to the prescribed limit and then promptly released.

[Cylinders loaded with 1,167 pounds=35,000 pounds per square inch.]

Initial height.	Final height.	Difference.
Inch.	*Inch.*	*Inch.*
.5006	.4486	.0520
.5003	.4476	.0527
.5006	.4471	.0525
.5005	.4472	.0533
.5001	.4466	.0535
Mean difference..		.0528

[Cylinders loaded with 1,333 pounds=40,000 pounds per square inch.]

.5005	.4344	.0661
.4999	.4364	.0635
.5002	.4366	.0636
.5005	.4364	.0641
.5007	.4364	.0643
Mean difference..		.0643

[Cylinders loaded with 1,500 pounds=45,000 pounds per square inch.]

.5004	.4245	.0759
.5005	.4200	.0805
.5005	.4233	.0772
.5003	.4264	.0739
.5004	.4246	.0758
Mean difference..		.0767

[Cylinders loaded with 1,667 pounds=50,000 pounds per square inch.]

.5002	.4110	.0892
.5002	.4101	.0901
.5006	.4119	.0887
.5004	.4131	.0873
.5006	.4118	.0888
Mean difference..		.0888

[Cylinders loaded with 1,833 pounds=55,000 pounds per square inch.]

.5004	.3976	.1028
.5002	.3987	.1015
.5004	.3988	.1016
.5006	.3992	.1014
.5003	.3988	.1015
Mean difference..		.1017

[Cylinders loaded with 2,000 pounds=60,000 pounds per square inch.]

.5004	.3836	.1168
.5003	.3867	.1136
.5004	.3860	.1144
.5010	.3844	.1166
.5006	.3863	.1143
Mean difference..		.1151

TARAGE TABLE FOR PRESSURE CYLINDERS FURNISHED WITH THE GOLAZ (FRENCH) APPARATUS.

Mean dimensions: Length, 0″.5113; diameter, 0″.3142.

Total loads applied.	Total compressions.											Mean corrected sets.
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	Mean.	
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*
100	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
200	.0006	.0004	.0001	.0002	.0008	.0003	.0004	.0004	.0002	.0001	.0004	.0003
400	.0016	.0017	.0003	.0010	.0023	.0008	.0010	.0014	.0004	.0010	.0012	.0010
600	.0048	.0054	.0046	.0043	.0052	.0028	.0036	.0047	.0010	.0042	.0041	.0038
800	.0084	.0090	.0090	.0083	.0089	.0058	.0073	.0089	.0037	.0081	.0077	.0073
1,000	.0127	.0132	.0126	.0124	.0133	.0095	.0114	.0130	.0076	.0121	.0118	.0112
1,200	.0175	.0176	.0175	.0175	.0179	.0150	.0164	.0173	.0127	.0171	.0167	.0161
1,400	.0225	.0227	.0228	.0222	.0232	.0185	.0210	.0224	.0168	.0220	.0214	.0206
1,600	.0277	.0276	.0278	.0270	.0279	.0244	.0267	.0273	.0219	.0279	.0266	.0256
1,800	.0334	.0339	.0336	.0328	.0337	.0296	.0323	.0335	.0278	.0329	.0324	.0314
2,000	.0389	.0391	.0392	.0386	.0391	.0342	.0371	.0394	.0323	.0389	.0377	.0365
2,200	.0448	.0448	.0462	.0440	.0452	.0417	.0438	.0445	.0387	.0447	.0438	.0426
2,400	.0513	.0510	.0511	.0500	.0513	.0472	.0494	.0508	.0451	.0505	.0498	.0485
2,600	.0573	.0578	.0580	.0563	.0573	.0522	.0563	.0575	.0505	.0576	.0561	.0548
2,800	.0646	.0644	.0644	.0643	.0642	.0595	.0628	.0653	.0581	.0640	.0632	.0618
3,000	.0718	.0711	.0722	.0705	.0710	.0656	.0697	.0716	.0654	.0714	.0700	.0685
3,200	.0794	.0781	.0789	.0779	.0788	.0728	.0770	.0796	.0719	.0788	.0773	.0758
3,400	.0865	.0865	.0863	.0856	.0850	.0806	.0841	.0868	.0791	.0864	.0847	.0832
3,600	.0943	.0939	.0944	.0934	.0936	.0890	.0918	.0943	.0866	.0950	.0925	.0910
3,800	.1018	.1013	.1025	.1012	.1005	.0953	.0995	.1021	.0942	.1029	.1001	.0986
4,000	.1093	.1084	.1094	.1080	.1082	.1032	.1067	.1098	.1015	.1088	.1073	.1057
4,200	.1175	.1180	.1170	.1160	.1168	.1103	.1138	.1170	.1091	.1171	.1153	.1137
4,400	.1259	.1248	.1260	.1240	.1240	.1175	.1223	.1255	.1175	.1261	.1234	.1218
4,600	.1334	.1338	.1338	.1329	.1325	.1260	.1298	.1330	.1257	.1339	.1315	.1299
4,800	.1409	.1405	.1414	.1404	.1398	.1345	.1386	.1420	1326	.1414	.1392	.1376
5,000	.1488	.1482	.1487	.1478	.1477	.1421	.1470	.1482	.1415	.1487	.1469	.1452
5,200	.1567	.1564	.1562	.1558	.1550	.1495	.1533	.1553	.1485	.1568	.1544	.1527
5,400	.1643	.1631	.1641	.1635	.1638	.1572	.1615	.1639	.1573	.1639	.1623	.1606
5,600	.1719	.1709	.1717	.1704	.1712	.1656	.1690	.1712	.1644	.1705	.1697	.1679
5,800	.1795	.1786	.1784	.1784	.1780	.1721	.1769	.1790	.1718	.1789	.1772	.1754
6,000	.1860	.1850	.1861	.1853	.1855	.1796	.1842	.1860	.1781	.1857	.1842	.1823
6,200	.1930	.1923	.1925	.1923	.1929	.1868	.1913	.1928	.1863	.1930	.1913	.1894
6,400	.2010	.1991	.1994	.1993	.1994	.1939	.1986	.1997	.1931	.1993	.1983	.1964
6,600	.2072	.2064	.2059	.2068	.2076	.2003	.2050	.2073	.1995	.2071	.2053	.2034
6,800	.2131	.2123	.2125	.2127	.2134	.2076	.2113	.2142	.2062	.2123	.2116	.2097
7,000	.2194	.2183	.2181	.2184	.2194	.2136	.2184	.2200	.2129	.2186	.2177	.2158
7,200	.2249	.2242	.2240	.2245	.2256	.2190	.2243	.2256	.2186	.2240	.2235	.2216
7,400	.2309	.2305	.2302	.2306	.2319	.2257	.2300	.2319	.2244	.2300	.2296	.2277
7,600	.2368	.2358	.2355	.2360	.2366	.2315	.2358	.2370	.2309	.2359	.2352	.2332
7,800	.2418	.2414	.2410	.2414	.2425	.2373	.2409	.2426	.2353	.2420	.2406	.2386
8,000	.2470	.2464	.2455	.2465	.2476	.2420	.2460	.2478	.2400	.2465	.2456	.2435
8,200	.2521	.2515	.2511	.2515	.2521	.2425	.2508	.2531	.2459	.2513	.2506	.2485
8,400	.2566	.2557	.2560	.2558	.2569	.2519	.2559	.2574	.2505	.2563	.2553	.2532
8,600	.2612	.2608	.2604	.2610	.2620	.2573	.2600	.2629	.2554	.2613	.2602	.2581
8,800	.2659	.2653	.2646	.2654	.2660	.2618	.2651	.2668	.2603	.2649	.2646	.2625
9,000	.2698	.2698	.2693	.2702	.2705	.2658	.2688	.2712	.2650	.2695	.2690	.2669
9,200	.2747	.2735	.2730	.2742	.2743	.2708	.2729	.2753	.2688	.2736	.2731	.2710
9,400	.2779	.2774	.2771	.2776	.2779	.2738	.2774	.2791	.2731	.2774	.2769	.2748
9,600	.2819	.2815	.2808	.2819	.2826	.2779	.2814	.2833	.2770	.2818	.2810	.2789
9,800	.2854	.2852	.2845	.2853	.2857	.2819	.2851	.2865	.2815	.2854	.2847	.2826
10,000	.2890	.2889	.2879	.2884	.2888	.2852	.2883	.2905	.2841	.2888	.2880	.2858
10,200	.2926	.2922	.2910	.2919	.2925	.2884	.2919	.2937	.2880	.2921	.2914	.2892
10,400	.2958	.2956	.2947	.2949	.2961	.2920	.2958	.2968	.2915	.2952	.2948	.2926
10,600	.2998	.2990	.2977	.2984	.2996	.2959	.2989	.3003	.2948	.2988	.2983	.2961
10,800	.3031	.3017	.3010	.3019	.3024	.2985	.3017	.3030	.2979	.3026	.3014	.2992
11,000	.3052	.3045	.3038	.3048	.3053	.3020	.3046	.3059	.3013	.3049	.3042	.3020
11,200	.3080	.3075	.3069	.3074	.3083	.3045	.3074	.3083	.3041	.3079	.3070	.3048
11,400	.3110	.3101	.3095	.3106	.3111	.3075	.3107	.3116	.3069	.3110	.3100	.3078
11,600	.3138	.3133	.3124	.3134	.3137	.3105	.3134	.3145	.3102	.3136	.3129	.3107
11,800	.3161	.3160	.3150	.3160	.3168	.3133	.3158	.3171	.3128	.3163	.3155	.3133
12,000	.3184	.3181	.3164	.3183	.3188	.3155	.3178	.3194	.3155	.3184	.3177	.3154
12,200	.3210	.3215	.3198	.3210	.3215	.3189	.3205	.3219	.3177	.3210	.3205	.3182
12,400	.3236	.3235	.3221	.3233	.3238	.3206	.3230	.3243	.3206	.3233	.3228	.3205
12,600	.3258	.3257	.3251	.3256	.3261	.3230	.3249	.3265	.3230	.3260	.3252	.3229
12,800	.3281	.3279	.3270	.3278	.3282	.3255	.3275	.3288	.3254	.3279	.3274	.3251
13,000	.3305	.3302	.3294	.3300	.3305	.3271	.3299	.3309	.3274	.3299	.3296	.3273
13,200	.3325	.3323	.3316	.3320	.3325	.3293	.3320	.3330	.3295	.3326	.3317	.3294
13,400	.3344	.3346	.3334	.3337	.3348	.3315	.3339	.3352	.3315	.3347	.3338	.3315
13,600	.3366	.3365	.3355	.3358	.3367	.3341	.3359	.3372	.3334	.3366	.3358	.3335
13,800	.3385	.3384	.3378	.3376	.3385	.3359	.3379	.3394	.3356	.3384	.3378	.3355
14,000	.3408	.3402	.3398	.3394	.3406	.3374	.3401	.3409	.3370	.3404	.3397	.3374
14,200	.3425	.3421	.3414	.3415	.3423	.3398	.3420	.3428	.3390	.3421	.3416	.3398
14,400	.3441	.3439	.3430	.3435	.3440	.3414	.3434	.3454	.3410	.3440	.3434	.3411
14,600	.3458	.3458	.3445	.3468	.3459	.3433	.3453	.3464	.3429	.3460	.3453	.3430
14,800	.3476	.3472	.3461	.3477	.3473	.3452	.3468	.3479	.3444	.3477	.3468	.3445
15,000	.3496	.3486	.3481	.3489	.3492	.3468	.3483	.3496	.3467	.3493	.3485	.3461

Nine cylinders of this lot were initially compressed with a load of 5,000 pounds, applied and immediately released.

Initial height.	Final height.	Difference.
Inch.	*Inch.*	*Inch.*
.5122	.3642	.1480
.5123	.3669	.1454
.5119	.3644	.1475
.5112	.3678	.1434
.5108	.3625	.1485
.5121	.3668	.1453
.5121	.3653	.1468
.5117	.3656	.1461
.5097	.3652	.1445
Mean....	.....	.1462

CHEMICAL ANALYSIS.

Copper	99.55
Iron	0.45

SMOKELESS POWDER.

SMOKELESS POWDER.

Compression tests were made upon samples one diameter long each, with flat ends. The compressibility of the material was determined by means of micrometer observations taken over all, on a gauged length extending from platform to platform of the testing machine. Loads were applied in increments, and the permanent set of the powder determined upon release to the initial load.

Early sets were found, which gradually increased as higher loads were applied. A stage was reached when a rapid rate of compression occurred, followed by a diminished rate which continued until cracks were developed in the material. The general type of fracture was a longitudinal crack opposite a perforation in the powder grain, extending inward radially to the perforation, and followed, as the distortion continued, by a circular crack through the circle of six holes.

Grains were selected for test which presented smooth, cylindrical surfaces, and for comparison those which had wrinkled or corrugated surfaces, attributed to differences in rate of drying. The period of rapid yielding was within the zone of 7,000 to 10,000 pounds per square inch compressive stress. Cracks developed under loads ranging from 12,000 to 28,000 pounds, and more complete failure of the material occurred under loads ranging from about 14,000 to 34,000 pounds per square inch.

A specimen from the central part of a grain gave results within the limiting values obtained on full diameter grains of the same lot of powder. Initial strains were found in each of the lots of powder. Thin rings, about ″.05± thickness of walls, which were taken from the outer parts of the grains, were cut apart radially. The ends of the rings closed in, showing that internal strains of compression were present in the outside layers of the grains. A ring from the central part of a grain of L & R Lot 1, 1901, 12-inch B. L. R., did not show the presence of strains. When first cut apart the several rings closed in an amount about equal to the thickness of the saw scarf, or ″.024. A subsequent examination of the detached rings showed the internal strains had apparently increased. Rings from Du Pont powders, Lots 2 and 6, for 8-inch and 10-inch B. L. R., and L & R Lot 1, 12-inch B. L. R., sprung together sufficiently for the ends to overlap, the latter powder showing the most marked effect, where the overlapping reached ″.20. The inner ring of this last lot remained unchanged when reexamined, no internal strains having manifested themselves.

Examined under the microscope the powder appears amorphous.

Compression Tests of Smokeless Powder.

No. 1184.

Sample marked, L & R, Lot 1, 1901, for 12″ B. L. R.
Length, ″.789; diameter, ″.808.
Seven perforations ″.073 diameter each.
Net sectional area, .4834 square inch.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
500	1,030	0.	0.	Initial load.
1,000	2,070	.0018	.....	
1,500	3,100	.0034	.....	
2,000	4,140	.0050	.....	
2,500	5,170	.0068	.....	
3,000	6,210	.0096	.0013	
3,500	7,240	.0200	.....	
4,000	8,270	.0892	.....	
4,500	9,310	.1850	.1731	
7,500	15,520	.40	.....	
9,000	18,630	.....	.39	Crack.
10,000	20,690	.....	.47	Six cracks developed opposite perforations.

No. 1185.

Sample marked, U. S. Navy, for 12″ B. L. R. From battle ship *Iowa*.
Length, ″.694; diameter, ″.695.
Seven perforations ″.086 diameter each.
Net sectional area, .3388 square inch.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
500	1,480	0.	0.	Initial load.
1,000	2,950	.0018	.....	
1,500	4,430	.0043	.0005	
2,000	5,900	.0070	.0010	
2,500	7,380	.0118	.0025	
3,000	8,850	.0190	.0048	
3,400	10,040	.....	.....	Rapid yielding.
3,500	10,330	.1150	.1021	
4,000	11,810	.22	.....	
5,000	14,760	.30	.....	
6,000	17,710	.33	.....	
6,800	20,070	.35	.....	Crack.
7,000	20,660	.....	.31	Four cracks.
7,500	22,140	.....	.....	Specimen broke up into ten fragments.

No. 1186.

Sample marked, International, Lot 2, 1902, 10″ B. L. R.
Length, ″.703; diameter, ″.695.
Seven perforations, ″.071 diameter each.
Net sectional area, .3517 square inch.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
500	1,420	0.	0.	Initial load.
1,000	2,840	.0020	.0001	
1,500	4,270	.0040	.0005	
2,500	7,110	.0114	.0028	
3,000	8,530	.0357	.0205	
3,500	9,950	.23	.....	
4,000	11,370	.27	.....	
4,500	12,800	.30	.....	
5,000	14,220	.32	.....	
6,000	17,060	.36	.....	
7,000	19,900	.38	.....	Crack.
7,800	22,180	.....	.....	General rupture of specimen.

No. 1187.

Sample marked, Du Pont, Lot 6, 1901, 10″ B. L. R.
Length, ″.692; diameter, ″.680 to ″.704.
Seven perforations ″.073 diameter each.
Net sectional area, .3467 square inch.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
500	1,440	0.	0.	Initial load.
1,000	2,880	.0029	.0008	
1,500	4,330	.0055	.0011	
2,000	5,770	.0096	.0025	
2,500	7,210	.0304	.0186	
3,000	8,650	.1738	.1625	
4,000	11,540	.20	.....	
4,200	12,110	.22	.....	Crack.
4,800	13,840	.....	.....	Maximum load applied. General disintegration followed under reduced loads. Ten principal fragments.

No. 1188.

Sample marked, Du Pont, Lot 2, 1901, 8″ B. L. R.
Length, ″.708; diameter, ″.695 to ″.705.
Seven perforations, ″.085 diameter each.
Net sectional area, .3449 square inch.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
500	1,450	0.	0.	Initial load.
1,000	2,900	.0023	.0013	
1,500	4,350	.0051	.0017	
2,000	5,800	.0096	.0028	
2,500	7,250	.0176	.0046	
3,000	8,700	.0370	.0210	
3,500	10,150	.23	.....	
4,000	11,600	.25	.....	
4,900	14,210	.30	.....	Crack.
5,800	16,820	.....	.....	Maximum load applied. General disintegration. Six principal fragments.

No. 1189.

Sample marked, Du Pont, Lot 3, 1900, 6″ Brown Segmental.
Length, ″.453; diameter, ″.443.
Seven perforations ″.044 diameter each.
Net sectional area, .1436 square inch.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
100	700	0.	0.	Initial load.
300	2,090	.0020	.....	
500	3,480	.0035	.0005	
700	4,870	.0050	.....	
1,000	6,960	.0085	.0011	
1,200	8,360	.0142	.....	
1,400	9,750	.1048	.....	
1,600	11,140	.15	.....	
1,800	12,540	.17	.....	
2,000	13,930	.20	.....	
2,500	17,410	.23	.....	
2,900	20,190	.25	.....	Crack.
3,600	25,070	.....	.....	Maximum load applied. General disintegration; radial cracks through perforations.

No. 1190.

Sample marked, Du Pont, Lot 5, 1901, 6″ R. F.
Length, ″.445; diameter, ″.429.
Seven perforations, ″.055 diameter each.
Net sectional area, .1277 square inch.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
100	780	0.	0.	Initial load.
300	2,350	.0020	.....	
500	3,920	.0038	.0004	
700	5,480	.0046	.....	
1,000	7,830	.0121	.0033	
1,200	9,400	.0455	.....	
1,400	10,960	.1475	.....	
1,600	12,530	.16	.....	
1,800	14,100	.19	.....	
1,950	15,270	.20	.....	Crack.
2,500	19,580	.29	.....	
2,800	21,930	.....	.....	Maximum load applied. General disintegration; radial cracks through perforations.

No. 1191.

Sample marked L & R, Lot 1, 1901, 12″ B. L. R.
Surface of sample much wrinkled.
Length, ″.745; diameter, ″.775 to ″.780.
Seven perforations, ″.082 diameter each.
Net sectional area, .4377 square inch.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
500	1,140	0.	0.	Initial load.
1,000	2,280	.0020	.0005	
1,500	3,430	.0040	.0008	
2,000	4,570	.0066	.0013	
2,500	5,710	.0120	.0030	
3,000	6,850	.0183	.0070	
3,500	8,000	.24	.....	
4,000	9,140	.26	.....	
5,000	11,420	.31	.....	
6,000	13,710	.36	.....	
7,000	15,990	.38	.....	
8,000	18,280	.41	.....	
9,000	20,560	.43	.....	
10,000	22,850	.44	.....	
11,800	26,960	.46	.....	Crack.
12,800	29,240	.....	.....	Maximum load applied. General disintegration; three cracks through perforations.

No. 1192.

Sample taken from the central part of piece of L & R, Lot No. 1, 1901.
Length, ".358; diameter, ".358.
One perforation, ".078 diameter.
Net sectional area, .0959 square inch.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
700	7,300	.....	.....	Decided yielding.
1,600	16,680	.18	.....	Crack opened.

No. 1193.

Sample marked L & R, Lot No. 1, 1901.
Length, ".774; diameter, ".800 to ".817.
Seven perforations, ".073 diameter each.
Net sectional area, .4840 square inch.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
500	1,030	0.	0.	Initial load.
1,000	2,070	.0019	.0004	
1,500	3,100	.0036	.0005	
2,000	4,130	.0057	.0009	
2,500	5,170	.0089	.0020	
3,000	6,200	.0129	.0035	
3,500	7,230	.0455	.0335	
4,000	8,260	.24	.....	
9,400	19,420	.44	.....	Crack.
11,700	24,170	.56	.....	Maximum load applied. General disintegration; four cracks through perforations.

No. 1194.

Sample marked L & R, Lot 1, 1901.
Length, ".767; diameter, ".783 to ".797.
Seven perforations, ".073 diameter each.
Net sectional area, .4608 square inch.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
500	1,090	0.	0.	Initial load.
1,000	2,170	.0015	.0002	
1,500	3,260	.0032	.0003	
2,000	4,340	.0053	.0005	
2,500	5,430	.0079	.0010	
3,000	6,510	.0163	.0051	
3,500	7,600	.0440	.0283	
4,000	8,680	.24	.....	
8,400	18,230	.43	.....	Crack.
10,800	23,440	.55	.....	Maximum load applied. General disintegration; five cracks through perforations.

No. 1195.

Sample marked, L & R, Lot 1, 1901.
Length, ".768; diameter, ".780 to ".790.
Seven perforations ".073 diameter each.
Net sectional area, .4546 square inch.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
500	1,100	0.	0.	Initial load.
1,000	2,200	.0020	.0002	
1,500	3,300	.0043	.0008	
2,000	4,400	.0061	.0011	
2,500	5,500	.0096	.0023	
3,000	6,600	.0140	.0035	
3,500	7,700	.0325	.0161	
4,000	8,800	.24	.....	
5,000	11,000	.33	.....	
6,500	14,300	.39	.....	Crack.
12,500	27,500	.57	.....	Maximum load applied. General disintegration; six cracks through perforations.

No. 1196.

Sample marked, International, Lot 2, 1902, 10″ B. L. R.
Length, ″.683; diameter, ″.702.
Seven perforations ″.07 diameter each.
Net sectional area, .3604 square inch.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
500	1,390	0.	0.	Initial load.
1,000	2,770	.0020	.0003	
1,500	4,160	.0040	.0009	
2,500	6,940	.0118	.0028	
3,000	8,320	.1410	.1323	
4,000	11,100	.28	.....	
6,000	16,650	.36	.....	
6,700	18,590	.38	.....	Crack.
7,800	21,640	.49	.....	Maximum load applied. General disintegration; three cracks through perforations.

No. 1197.

Sample marked, International, Lot 2, 1902, 10″ B. L. R.
Surface of sample wrinkled.
Length, ″.689; diameter, ″.666 to ″.713.
Seven perforations, center one ″.082 diameter, and six outside ones ″.069 diameter each.
Net sectional area, .3459 square inch.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
500	1,450	0.	0.	Initial load.
1,000	2,890	.0020	.0003	
1,500	4,340	.0042	.0005	
2,000	5,780	.0075	.0015	
2,500	7,230	.0195	.0084	
2,800	8,090	.0370	.....	
2,800	8,090	.1000	.....	After sustaining load 2 minutes.
3,000	8,670	.1900	.1815	
4,000	11,560	.31	.....	
6,000	17,350	.37	.....	
7,800	22,550	.41	.....	Crack.
10,600	30,640	.56	.....	Maximum load applied. General disintegration.

No. 1198.

Sample marked, Du Pont, Lot 6, 10″ B. L. R.
Surface of sample wrinkled.
Length, ″.687; diameter, ″.695 to ″.704.
Seven perforations ″.078 diameter each.
Net sectional area, .3507 square inch.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
500	1,430	0.	0.	Initial load.
1,000	2,850	.0024	.0003	
1,500	4,280	.0051	.0006	
2,000	5,700	.0088	.0018	
2,500	7,130	.1414	.0290	
3,000	8,550	.20	.....	
4,000	11,410	.28	.....	
4,900	13,970	.30	.....	Crack.
5,700	16,250	.44	.....	Maximum load applied. General disintegration. Nine principal fragments.

No. 1199.

Sample marked, Du Pont, Lot 6, 1901, 10″ B. L. R.
Surface of sample smooth.
Length, ″.695; diameter, ″.694 to ″.689.
Seven perforations ″.075 diameter each.
Net sectional area, .3448 square inch.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
500	1,450	0.	0.	Initial load.
1,000	2,900	.0028	.0005	
1,500	4,350	.0055	.0010	
2,000	5,800	.0095	.0016	
2,500	7,250	.0280	.0143	
2,800	8,120	.0935	.....	
3,000	8,700	.1845	.1740	
4,000	11,600	.29	.....	
5,400	15,660	.32	.....	Crack.
6,100	17,690	.45	.....	Maximum load applied. General disintegration. Six principal fragments.

No. 1200.

Sample marked, U. S. Navy, 12″ B. L. R., from battle ship *Iowa*.
Length, ″.685; diameter, ″.686.
Seven perforations ″.085 diameter each.
Net sectional area, .3297 square inch.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
500	1,520	0.	0.	Initial load.
1,000	3,030	.0028	.0006	
1,500	4,550	.0055	.0009	
2,000	6,070	.0084	.0016	
2,500	7,580	.0138	.0026	
2,800	8,490	.0260	.....	
3,000	9,100	.0500	.0031	
3,200	9,710	.1340	.....	
3,500	10,620	.19	.....	
4,000	12,130	.23	.....	
5,000	15,170	.28	.....	
6,000	18,200	.33	.....	
6,500	19,710	.34	.....	Crack.
7,600	23,050	.45	.....	Maximum load applied. General disintegration. Four principal fragments.

No. 1201.

Sample marked, Du Pont, Lot 2, 1901, 8″ B. L. R.
Surface of sample smooth.
Length, ″.680; diameter, ″.683 to ″.703.
Seven perforations ″.085 diameter each.
Net sectional area, .3373 square inch.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
500	1,480	0.	0.	Initial load.
1,000	2,960	.0022	.0002	
1,500	4,450	.0049	.0004	
2,000	5,930	.0079	.0009	
2,500	7,410	.0178	.0048	
3,000	8,890	.1525	.....	
4,000	11,860	.24	.....	
4,900	14,530	.29	.....	Crack.
6,000	17,790	.37	.....	
6,600	19,570	.48	.....	Maximum load applied. General disintegration. Six principal fragments.

No. 1202.

Sample marked, Du Pont, Lot 2, 1901, 8″ B. L. R.
Surface of sample wrinkled.
Length, ″.692; diameter, ″.664 to ″.681.
Seven perforations ″.085 diameter each.
Net sectional area, .3153 square inch.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
500	1,590	0.	0.	Initial load.
1,000	3,170	.0028	.0005	
1,500	4,760	.0056	.0009	
2,000	6,340	.0105	.0018	
2,500	7,930	.0365	.0220	
3,000	9,510	.20	.....	
3,900	12,370	.23	.....	Crack.
5,000	15,860	.38	.....	
5,600	17,760	.49	.....	Maximum load applied. General disintegration. Three principal fragments.

No. 1203.

Sample marked, Du Pont, Lot 3, 1900, 6″ Brown Segmental.
Length, ″.421; diameter, ″.426.
Seven perforations ″.052 diameter each.
Net sectional area, .1278 square inch.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
100	780	0.	0.	Initial load.
300	2,350	.0019	.0001	
500	3,910	.0034	.0003	
700	5,480	.0048	.0005	
1,000	7,830	.0089	.0015	
1,200	9,390	.0200	.0089	
1,400	10,960	.1395	.....	
1,600	12,520	.15	.....	
1,800	14,080	.18	.....	
2,000	15,650	.19	.....	
2,200	17,210	.20	.....	
2,500	19,560	.21	.....	
3,000	23,480	.23	.....	
3,700	28,950	.24	.....	Crack.
4,400	34,430	.33	.....	Maximum load applied. General disintegration.

No. 1204.

Sample marked, Du Pont, Lot 3, 1900, 6″ Brown Segmental.
Length, ″.424; diameter, ″.433.
Seven perforations ″.052 diameter each.
Net sectional area, .1326 square inch.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
100	750	0.	0.	Initial load.
300	2,260	.0026	.0006	
500	3,770	.0041	.0006	
700	5,280	.0060	.0010	
1,000	7,540	.0111	.0024	
1,200	9,050	.0280	.0152	
1,400	10,560	.1077	.....	
1,600	12,070	.13	.....	
1,800	13,570	.16	.....	
2,000	15,080	.18	.....	
2,500	18,850	.21	.....	
3,000	22,620	.22	.....	
3,700	27,900	.23	.....	Crack.
4,200	31,670	.31	.....	Maximum load applied. General disintegration.

No. 1205.

Sample marked, Du Pont, Lot 5, 6″ R. F.
Length, ″.438; diameter, ″.431 to″ .436.
Seven perforations ″.055 diameter each.
Net sectional area, .1308 square inch.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
100	760	0.	0.	Initial load.
300	2,290	.0019	.0003	
500	3,820	.0035	.0004	
700	5,350	.0055	.0009	
1,000	7,650	.0110	.0030	
1,200	9,170	.0598	.0500	
1,400	10,700	.15	.....	
1,600	12,230	.16	.....	
1,800	13,760	.18	.....	
1,900	14,530	.19	.....	Crack.
2,300	17,580	.29	.....	Maximum load applied. General disintegration.

No. 1206.

Sample marked, Du Pont, Lot 5, 6″ R. F.
Length, ″.433; diameter, ″.416 to ″.423.
Seven perforations ″.055 diameter each.
Net sectional area, .1214 square inch.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
100	820	0.	0.	Initial load.
300	2,470	.0019	.0001	
500	4,120	.0034	.0004	
700	5,770	.0058	.0010	
1,000	8,240	.0265	.0158	
1,200	9,890	.1125	.....	
1,400	11,530	.15	.....	
1,600	13,180	.18	.....	
1,800	14,830	.20	.....	
1,850	15,240	.21	.....	Crack.
2,300	18,950	.33	.....	Maximum load applied. General disintegration.

PROOF STRESSES.

PISTON RODS.

Number of rods.	For—	Proof stress applied.
		Pounds.
10	5-inch barbette carriage, model 1903	186,000
8	6-inch disappearing carriage, model 1903	44,000
5	15-pounder mount	131,966
1	10-inch disappearing carriage, model 1896	100,000
4	10-inch disappearing carriage, model 1901	240,000

RETRACTION ROPES.

Number of ropes.	For—	Proof stress applied.
		Pounds.
35	6-inch disappearing carriage	9,000
10	8-inch disappearing carriage	9,000
33	10-inch disappearing carriage, model 1896	11,000
13	10-inch disappearing carriage, model 1901	15,000
59	12-inch disappearing carriage	15,000

WHEELS

FOR 3-INCH FIELD CARRIAGES.

Tests of Wheels for 3-Inch Field Carriages.

Three wheels were received from the Bethlehem Steel Company and three from the Archibald Wheel Company.

Two wheels of each make were tested by loads applied at the rims, at four places equidistant, in the manner preceding tests have been carried out. One wheel of each lot was tested for endurance against repeated deflections by applying pressure against the rim at one place and running the wheel definite numbers of times, with different amounts of sidewise deflection.

In making the tests by repeated deflection, each wheel was placed in a lathe and pressure applied at the rim by means of a roller fixture. This roller was crowded against the rim, in the first 1,000 rotations the deflection being ¼ inch, the speed of rotation being about 7 per minute. This was followed by a second run of the same number of rotations, the deflection now being ½ inch, and this in turn was succeeded by the last run, in which the deflection was increased to ¾ inch. In all, the wheel was thus rotated 3,000 times in an undishing direction. This test was then followed by similar runs, the deflections now being in the direction of increasing the amount of dishing.

There was no appreciable injury done to the wheels under the runs of ¼-inch deflection. With deflections of ½ inch each wheel showed a perceptible movement of the spokes at the hub. This movement was more pronounced when the deflections were increased to ¾ inch. The paint was disturbed about the spokes where they entered the hub flanges. There was a sluggish recovery from deflections of ¾ inch, the Archibald make of wheel eventually recovering the full amount. The Bethlehem wheel did not fully recover from the deflection of ¾ inch within the time limit of the observation. The latter wheel was finally run with a deflection of 1 inch in an undishing direction, the recovery from which was ¾ inch, the permanent set being ¼ inch.

It appears that deflections of the rim at one place result in perceptible movement of the spokes in the hubs in each make of wheel, when the deflection reaches or exceeds ½ inch in either a dishing or an undishing direction.

TESTS OF 3-INCH FIELD CARRIAGE WHEELS RECEIVED FROM BETHLEHEM STEEL COMPANY.

Wheels have 16 spokes and ½ " tires.
Loaded at rims at four points, equidistant; supported at hub.
Loads applied in an undishing direction.

First Wheel.

Amount of dishing, ".52 ±.

Applied loads.	Approximate undishing movement.	Remarks.
Pounds.	*Inch.*	
500	0.	Initial load.
1,000	.07	
1,500	.11	
2,000	.18	
2,500	.23	
3,000	.31	
3,500	.39	
4,000	.47	Dishing removed.
4,500	.58	
5,000	.67	
5,420	.75	
500	.19	
6,000	.88	
6,420	1.00	
500	.25	
4,610	.75	
500	.25	Hub cap tightened.
500	.27	
1,000	.31	
2,000	.44	
3,000	.55	
4,000	.70	
4,560	.75	
6,310	1.00	
500	.27	

Second Wheel.

Amount of dishing, ".72; hub cap tightened.

Applied loads.	Approximate undishing movement.	Remarks.
Pounds.	*Inch.*	
500	0.	Initial load.
1,000	.06	
1,500	.10	
2,000	.17	
2,500	.31	
3,000	.28	
3,500	.33	
4,000	.40	
4,500	.50	
5,000	.60	
5,500	.72	Dishing removed.
5,550	.75	
6,000	.90	
6,240	1.00	
500	.26	
4,560	.75	
500	.26	

TESTS OF 3-INCH FIELD CARRIAGE WHEELS RECEIVED FROM ARCHIBALD WHEEL COMPANY.

Wheels have 16 spokes and ½" tires.
Loaded at rims at four points, equidistant; supported at hub.
Loads applied in an undishing direction.

FIRST WHEEL.

Amount of dishing, ".85.

Applied loads.	Approximate undishing movement.	Remarks.
Pounds.	*Inch.*	
500	0.	Initial load.
1,000	.05	
1,500	.12	
2,000	.20	
2,500	.26	
3,000	.33	
3,500	.40	
4,000	.47	
4,500	.53	
5,000	.60	
5,500	.86	Dishing removed.
5,750	1.26	Dishing reversed with a lurching movement; continuous yielding for a time.
500	.32	
500	.28	
5,000	1.02	
500	.36	
4,000	.81	
500	.36	

SECOND WHEEL.

Amount of dishing, ".77.

Applied loads.	Approximate undishing movement.	Remarks.
Pounds.	*Inch.*	
500	0.	Initial load.
1,000	.07	
1,500	.13	
2,000	.18	
2,500	.24	
3,000	.30	
3,500	.36	
4,000	.42	
4,500	.45	
5,000	.48	
5,500	.63	Dishing removed.
5,500	.88	After sustaining load 20 minutes.
500	.29	
5,000	.76	
5,000	.79	After sustaining load 6 minutes.
500	.29	
4,000	.74	
500	.29	

TESTS OF TWO WHEELS RECEIVED FROM THE ARCHIBALD WHEEL COMPANY, LAWRENCE, MASS.

DESCRIPTION OF THE TESTS.

Two wheels for 3-inch carriages were received from the Archibald Wheel Company, Lawrence, Mass. The wheels had 16 spokes each, ½-inch tires, with rim or felloe 2⅞ inches deep. One wheel had a bent rim of two sections, the other an eight-section sawed felloe.

They were tested by loads applied on the tires, acting diametrically inward, first applying the loads over the end joints of the rim or the felloe, second at places midway the length of the rim or felloe. The direct inward radial movements were observed along the loaded diameters, and the induced outward radial movements along diameters 90° therefrom.

Following the tests of these two wheels of 2⅞-inch depth of rim, a test was made of wheel No. 2 of the next previous lot of wheels from the Archibald Wheel Company which had a rim 2½ inches deep. This wheel had previously been subjected to an undishing test by loads applied at the rim in four places.

DISCUSSION OF THE RESULTS.

The comparative resistance of the first two wheels was not materially different against loads applied diametrically inward, up to loads approaching 20,000 pounds, so far as pertained to the relative resistance of the rims. In the case of the sectional felloes, the diametrical movement was augmented under the higher loads by the bending of the spokes near the point of application of the loads, referring to the tests in which the loads were applied over the end joints of the rim or felloe.

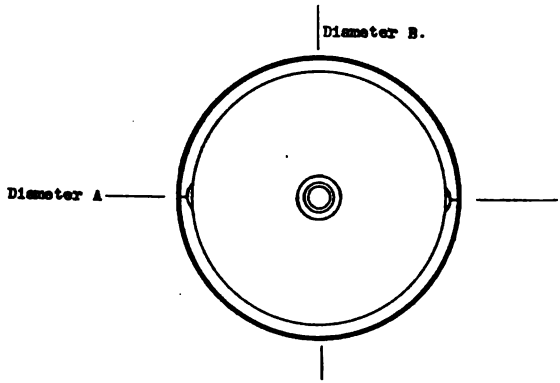
In the succeeding tests where the loads were applied midway the joints the higher loads caused bending of the spokes of the bent rim wheel, which resulted necessarily in increased diametrical movement being observed at this stage.

The several spokes nearest the loaded diameters sustained the stresses generally with very slight or hardly perceptible movement inward in the hub flanges. Each wheel seemed strong in respect to the movement of the spokes within the hubs, movements not exceeding ″.01 to ″.03 occurring where such were observable.

The dishing of the wheels remained without sensible change, showing that pressure applied as a direct downward load does not result in overloading the hub flanges.

The retest of the bent-rim wheel of 2⅛-inch depth of rim showed lower resistance of this wheel in comparison with those of 2⅞-inch depth of rim in both positions of loading. The lighter rim of this wheel sprung away from contact with the ends of the spokes remote from the place of loading.

TESTS OF TWO WHEELS RECEIVED FROM THE ARCHIBALD WHEEL COMPANY, LAWRENCE, MASS.

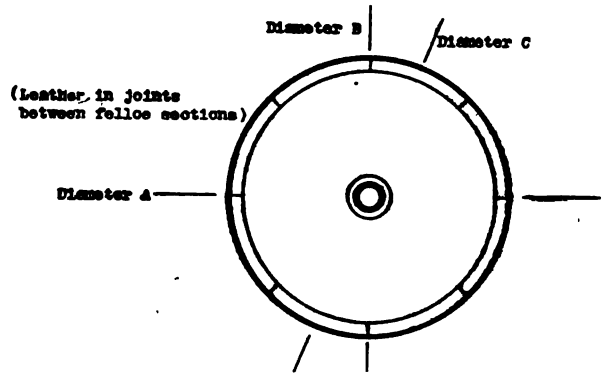


16-spoke wheel; ½-inch tire.
Bent rim; 2 pieces; depth of rim 2⅞″.
Loaded on diameter A.
Movements observed on diameter A were inward, radially; on diameter B outward, radially.

Applied loads.	Movement of diameter—		Remarks.
	A.	B.	
Pounds.	*Inch.*	*Inch.*	
500	0.	0.	Initial load.
1,000	0.	.....	
1,500	0.	.....	
2,000	0.	.....	
2,500	0.	.....	
3,000	0.	.....	
3,500	0.	.....	
4,000	.01−	.....	
4,500	.01	.....	
5,000	.01+	.....	
5,500	.02	.....	
6,000	.02+	0.	
6,500	.03	.....	
7,000	.05	.....	
7,500	.06	.....	
8,000	.07	.....	
8,500	.08	.....	
9,000	.09	.....	
9,500	.10	.....	
10,000	.12	0. +	
10,500	.14	.....	
11,000	.15	.....	
11,500	.16	.....	
12,000	.18	.....	
12,500	.21	.....	
13,000	.24	.....	
13,500	.26	.....	
14,000	.28	.....	
15,000	.30	.....	
16,000	.35	.....	
17,000	.40	.....	
18,000	.45	.02+	
19,000	.50	.....	Joints at inside of rim open ″.11 each.
20,000	.58	.....	
25,000	.87	.15	Spokes moved inward in hub at one side.
500	.38	.07	

Wheel rotated one-fourth turn and loaded on diameter B.

Applied loads.	Movement of diameter—		Remarks.
	B.	A.	
Pounds.	*Inch.*	*Inch.*	
500	0.	0.	Initial load.
1,000	0.	.....	
2,000	0.	.....	
3,000	0.	.....	
4,000	.01−	.....	
5,000	.01+	.....	
6,000	.02+	.....	
7,000	.05	.....	
8,000	.06	.....	
9,000	.08	.....	
10,000	.10	.....	
11,000	.14	.....	
12,000	.15	.....	
14,000	.20	.....	
16,000	.26	.....	
18,000	.35	.....	
20,000	.43	.....	
25,000	.78	.....	Two adjacent spokes bent abreast where load was applied.
500	.43	.....	



16-spoke wheel, ½-inch tire.
Eight-section sawed felloe; depth of felloe, 2⅞ inches.
Loaded on diameter A.

Applied loads.	Movement of diameter— A.	Movement of diameter— B.	Remarks.
Pounds.	*Inch.*	*Inch.*	
500	0.	0.	Initial load.
1,000	0.	.....	
2,000	0.	.....	
3,000	.01−	.....	
4,000	.01	.....	
5,000	.02	.....	
6,000	.05	.....	
7,000	.07	.....	
8,000	.10	0.	Joints in felloe opened ".01 each at ends of loaded diameters.
9,000	.12	.....	
10,000	.14	.....	
12,000	.19	.....	
14,000	.27	.....	
16,000	.34	.06	Joints in felloe open ".08 each.
18,000	.47	.....	
20,000	.57	.....	
25,000	1.08	.....	Two spokes bent.
500	.51	.....	

Wheel rotated three-sixteenths and loaded on diameter C.

Applied loads.	Movement of diameter C.	Remarks.
Pounds.	*Inch.*	
500	0.	Initial load.
1,000	0.	
2,000	0.	
3,000	.01−	
4,000	.01+	
5,000	.03	
6,000	.05	
7,000	.06	
8,000	.08	
9,000	.10	
10,000	.11	
12,000	.15	
14,000	.19	
16,000	.24	
18,000	.30	
20,000	.37	
25,000	.60	
500	.25	

Archibald wheel No. 2, of previous lot.
16-spoke wheel; ½-inch tire; 2⅛-inch rim.
Loaded over end joints of rim.

Applied loads.	Movement of diameter—		Remarks.
	A.	B.	
Pounds.	*Inch.*	*Inch.*	
500	0.	0.	Initial load.
1,000	0.	.....	
2,000	0.	.....	
3,000	.01−	.....	
4,000	.02	.....	
5,000	.07	.....	
6,000	.11	.....	
7,000	.15+	.....	
8,000	.20	.....	
9,000	.24	.....	
10,000	.27	.....	
12,000	.36	.....	
14,000	.48	.....	Opening of joint in rim, ".06.
16,000	.59	.....	
18,000	.75	.....	
20,000	.90	.10	Rim began to split at each end
25,000	1.33	.....	Rim left all but 4 spokes.
500	.76	.....	

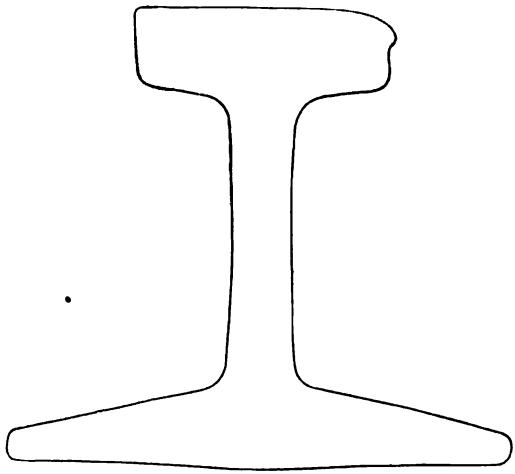
Wheel rotated one-fourth turn and loaded on diameter B, midway length of half rim.

Applied loads.	Movement of diameter—		Remarks.
	A.	B.	
Pounds.	*Inch.*	*Inch.*	
500	0.	0.	Initial load.
1,000	.....	0.	
2,000	.....	.01−	
3,000	.....	.01+	
4,000	.....	.05	
5,000	.....	.08	
6,000	.....	.11	
7,000	.....	.14	
8,000	.....	.18	
9,000	.....	.21	
10,000	.....	.26	
12,000	.....	.34	
14,000	.....	.45	
16,000	.....	.59	
18,000	.....	.72	
20,000	.....	.83	Rim leaves ends of spokes.
25,000	.....	1.33	3 spokes have decided bend.
500	.....	.77	

RAILROAD MATERIAL.

STEEL RAILS FROM BOSTON ELEVATED RAILWAY.

Pieces 6 feet long each from two worn rails, furnished by Mr. C. S. Sergeant, vice-president Boston Elevated Railway Company.



Rail branded: "235 Maryland 111111 02."
Taken out of northern half of reverse curve, leaving Park street, south bound.
Inside rail, put in December 30, 1902.
Relaid, January 5, 1904.
Life of rail, 370 days.

TRANSVERSE TEST, WITH HEAD ON THE TENSION SIDE.

Total height, 4.73 inches.
Distance to neutral axis from top of rail, 2.63 inches.
Moment of inertia = 23.1.
Ends supported 24 inches apart; loaded at the middle.

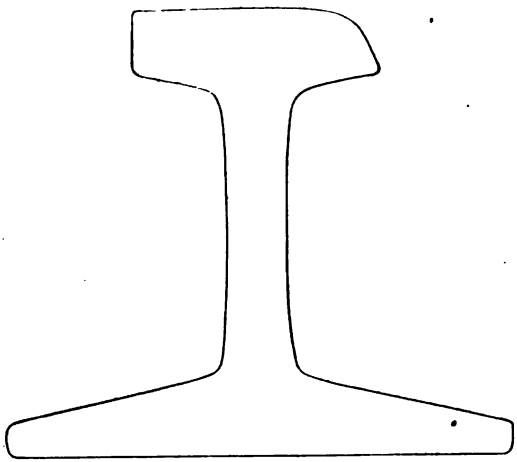
Ultimate strength, total	pounds..	159,000
Modulus of rupture, per square inch	do....	108,620

Appearance of fracture, granular, radiating from a point on the side of the rail at the top surface of the head.
Rail bent through an angle of 2½° at time of fracture.

TRANSVERSE TEST, WITH BASE ON THE TENSION SIDE.

Ultimate strength, total	pounds..	246,000
Modulus of rupture, per square inch	do....	168,050

Appearance of fracture, granular, radiating from a point in the base near the center of the cross section of one flange.
Rail bent through an angle of 7° at time of fracture.



Rail branded: "Cambria—85 lbs.—No. 531—1903 111."
Outer rail at Scollay Square, south bound.
Put in track, April 10, 1903.
Taken out, December 31, 1903.
Life of rail, 261 days.

TRANSVERSE TEST, WITH HEAD ON THE TENSION SIDE.

Total height, 4.59 inches.
Distance to neutral axis from top of rail, 2.62 inches.
Moment of inertia = 20.93.
Ends supported 24 inches apart; loaded at the middle.

Ultimate strength, total	pounds..	166,900
Modulus of rupture, per square inch	do....	125,350

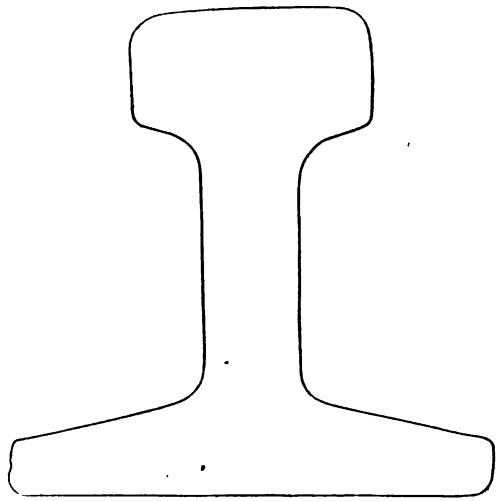
Appearance of fracture, granular, radiating from a point on side of head.
Rail bent through an angle of 3° at time of fracture.

TRANSVERSE TEST, WITH BASE ON THE TENSION SIDE.

Maximum load applied	pounds..	220,000
Maximum fiber stress, per square inch	do....	165,240

Test discontinued; rail not fractured.
Rail bent through an angle of 13°.

MANGANESE (CAST) STEEL RAIL.



Length of specimen, 6 feet.

Total weight, 211.5 pounds.

Rail branded: "Taylor Iron & Steel Co. Manganese Steel. Wm. Wharton Jr. & Co., Inc., Philadelphia, Pa."

The manganese-steel rail represents metal in use in the tracks of the Boston Elevated Railway Company, where it has displayed phenomenal resistance against wear. The rails in the tracks occupy a place on a curve in the subway where exceptional wear has occurred, the average life of a carbon-steel rail having been 44 days at this place. During this time the heads of carbon-steel rails have been worn down about ′.065.

The manganese steel has been in use 4 years 5 days, with a loss in metal from the head of the rail, due to wear, of only ′.029. Its life has reached that of about 33 carbon-steel rails, with serviceability not yet impaired.

This test rail was contributed by Messrs. Harrington, Robinson & Co., Boston, Mass. In composition and treatment it is believed to be like the metal in the track.

Transverse Test, with Base on the Tension Side.

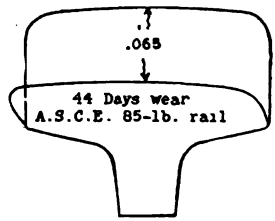
Total height, 5.16 inches.
Distance to neutral axis from top of rail, 2.84 inches.
Moment of inertia = 36.875.
Ends supported 54 inches apart; loaded at the middle.

Applied loads.		Deflections.	Deflection sets.	Remarks.
Total.	Modulus of rupture per square inch.			
Pounds.	*Pounds.*	*Inch.*	*Inches.*	
2,000	.....	0.	0.	Initial load.
4,000	.....	.0110	.....	
6,000	.....	.0197	.....	
8,000	.....	.0288	.....	
10,000	.....	.0372	.0030	
12,000	.....	.0446	.....	
14,000	.....	.0536	.....	
16,000	.....	.0615	.....	
18,000	.....	.0695	.....	
20,000	.....	.0774	.0051	
22,000	.....	.0860	.....	
24,000	.....	.0939	.....	
26,000	.....	.1024	.....	
28,000	.....	.1102	.....	
30,000	.....	.1190	.0079	
32,000	.....	.1282	.....	
34,000	.....	.1363	.....	
36,000	.....	.1455	.....	
38,000	.....	.1546	.....	
40,000	.....	.1645	.0147	
42,000	.....	.1750	.....	
44,000	.....	.1852	.....	
46,000	.....	.1966	.....	
48,000	.....	.2085	.....	
50,000	.....	.2210	.0335	
52,000	.....	.2347	.....	
54,000	.....	.2485	.....	
56,000	.....	.2641	.....	
58,000	.....	.2803	.....	
60,000	.....	.2981	.0735	
62,000	.....	.3185	.....	
64,000	.....	.3396	.0996	
68,000	.....	.....	.15	
72,000	.....	.....	.20	
76,000	.....	.....	.30	
80,000	.....	.....	.43	
84,000	.....	.....	.65	
88,000	.....	.....	.97	
92,000	.....	.....	1.40	
96,000	.....	.....	1.89	
100,000	.....	.....	2.57	
104,000	.....	.....	3.15	
108,000	.....	.....	4.00	
111,500	115,930	.....	4.98	Ultimate strength.

Appearance of fracture, granular; irregular surface.
Rail bent through an angle of 21° at time of fracture.

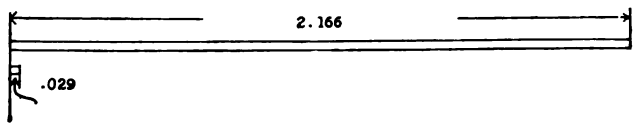
SECTIONS SHOWING THE COMPARATIVE WEAR OF ORDINARY STEEL RAILS AND MANGANESE-STEEL RAILS, LAID ON THE OUTER SOUTH HALF OF REVERSE CURVE ENTERING PARK STREET STATION, SOUTH BOUND, BOSTON SUBWAY. RADIUS, 82 FEET.

Section of rail laid March 13 and removed April 26, 1902; commercial rail.



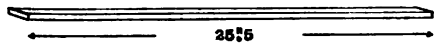
Section of manganese-steel rail laid April 26, 1902; section taken May 1, 1906—1,466 days, or 4 years and 5 days.

Graphic illustration showing comparative wear of ordinary and manganese steel for 1,466 days.



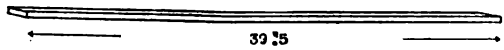
TENSILE TESTS OF SPECIMENS FROM MANGANESE-STEEL SWITCH RAIL FROM THE BOSTON ELEVATED RAILWAY COMPANY.

Specimen drawn down from fragment of rail after fracture by transverse test. Annealed after drawing down.



Sectional area, 1″.26 × ″.28 = .3528 square inch.
Tensile strength, total, 47,300 pounds.
Tensile strength per square inch, 134,070 pounds.
Area at fracture, 1″.16 × ″.25 = .29 square inch.
Contraction of area, 17.8 per cent.
Appearance of fracture, fine granular, slightly lammelar.
Cross-section dimensions. after fracture and remote from place of fracture, 1″.16 × ″.26.

Specimen drawn down from fragment of rail after fracture by transverse test. Worked at a low red heat, reheated, and annealed in sand.



Tested in the forged condition. Metal too hard to admit of machining.

Sectional area, 1″.62 × ″.42 = .68 square inch.

Gauged length, 6″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Elongation.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
680	1,000	0.	0.	Initial load.
3,400	5,000	.0008	0.	
6,800	10,000	.0018	0.	
10,200	15,000	.0028	0.	
13,600	20,000	.0038	0.	
17,000	25,000	.0040	0.	
20,400	30,000	.0057	0.	
23,800	35,000	.0068	0.	
27,200	40,000	.0079	0.	
30,600	45,000	.0089	.0001	
34,000	50,000	.0102	.0004	
37,400	55,000	.0119	.0009	
40,800	60,000	.0144	.0024	
44,200	65,000	.0184	.0054	
47,600	70,000	.0254	.0114	
51,000	75,000	.0365	.0212	
54,400	80,000	.0572	.0404	
57,800	85,000	.0730	.0551	
61,200	90,000	.1095	.0894	
64,600	95,000	.1400	.....	
68,000	100,000	.1945	.1696	
.....	10,000	.1714	.....	
.....	20,000	.1736	.....	
.....	30,000	.1758	.....	
.....	40,000	.1779	.....	
.....	50,000	.1800	.....	
.....	60,000	.1823	.....	
.....	50,000	.1801	.....	
.....	40,000	.1780	.....	
.....	30,000	.1760	.....	
.....	20,000	.1738	.....	
.....	10,000	.1716	.1696	
74,800	110,000	.....	.....	Tensile strength.
0	0	.88	.....	= 5.5 per cent elongation in 16″.

Elongation of inch sections: ″.07, ″.06, ″.06, ″.07, ″.06, ″.06, ″.03, ″.04, ″.05, ″.05, ″.05, ″.07, ″.04, ″.09*, ″.05, ″.03.

Area at fracture, 1″.56 × ″.41 = .64 square inch.

Contraction of area, 5.9 per cent.

Appearance of fracture, fine granular, radiating from the center of the bar.

TRANSVERSE, TENSILE AND HARDNESS TESTS OF STEEL RAILS RECEIVED FROM THE BOSTON ELEVATED RAILWAY COMPANY.

TRANSVERSE TESTS.

Test No. 754.

TREATED RAIL.

Branded "Cambria 85 lbs. No. 531, 1903 1111."
Length, 144″.65.
Weight, 269 pounds; 85 pounds per yard.
Height, 5″.19.
Width of head, 2″.55.
Width of base, 5″.16.
Thickness of web, ″.57.
Distance between end supports, 54 inches.
Loaded at the middle, on the base.

Total applied loads.	Deflections.	Deflection sets.	Remarks.
Pounds.	*Inch.*	*Inch.*	
2,000	0.	0.	Initial load.
4,000	0.	.....	
6,000	.01	.....	
8,000	.02	.....	
10,000	.03	.....	
12,000	.04	.....	
14,000	.05	.....	
16,000	.07	.....	
17,000	.08	.....	
18,000	.09	.....	
20,000	.09	.....	
21,000	.10	.....	
22,000	.10	.....	
24,000	.11	.....	
26,000	.11	.....	
28,000	.12	.....	
30,000	.13	.....	
32,000	.14	.....	
34,000	.15	.....	
36,000	.17	.....	
38,000	.19	.....	
40,000	.19	.....	
42,000	.20	.....	
44,000	.20	.....	
46,000	.21	.....	
48,000	.22	.....	
50,000	.22	.....	
52,000	.24	.....	
54,000	.26	.....	
56,000	.28	.....	
58,000	.29	.....	
60,000	.30	.....	
62,000	.30	.....	
64,000	.31	.....	
66,000	.35	.....	
67,000	.37	.....	
68,000	.38	.....	
69,000	.39	.....	
70,000	.40	.....	
72,000	.41	.....	
73,000	.42	.....	
74,000	.44	.....	
76,000	.50	.....	
77,000	.51	.....	
78,000	.53	.....	
79,000	.56	.....	
80,000	.59	.23	
81,000	.61	.....	
82,000	.62+	.....	
84,000	.70	.....	
86,000	.77	.....	

Test No. 754—Continued.

Total applied loads.	Deflections.	Deflection sets.	Remarks.
Pounds.	*Inches.*	*Inch.*	
88,000	.85	.....	
90,000	.92	.51	
92,000	1.00	.....	
94,000	1.09	.....	
96,000	1.20	.....	
98,000	1.29	.....	
100,000	1.40	.....	
102,000	1.50	.....	
104,000	1.61	.....	
109,500	.....	.....	Ultimate strength.

Granular fracture, beginning from a point near the middle of the width of the head, and $1\frac{1}{8}$ inches below the top surface of the head.

UNTREATED RAIL.

Branded "285 Maryland 111111 02."
Length, 114″.05.
Weight, 267 pounds; 84 pounds per yard.
Height, 5″.21.
Width of head, 2″.57.
Width of base, 5″.22.
Thickness of web, ″.57.
Distance between end supports, 54″.
Loaded at the middle, on the base.

Total applied loads.	Deflections.	Deflection sets.	Remarks.
Pounds.	*Inches.*	*Inch.*	
2,000	0.	0.	Initial load.
4,000	0.	.....	
6,000	.01	.....	
8,000	.02	.....	
10,000	.03	.....	
12,000	.04	.....	
14,000	.05	.....	
16,000	.06	.....	
18,000	.07	.....	
20,000	.08	.....	
22,000	.09	.....	
24,000	.10	.....	
26,000	.11	.....	
28,000	.11+	.....	
30,000	.12	.....	
32,000	.13	.....	
34,000	.14	.....	
36,000	.15	.....	
38,000	.17	.....	
40,000	.18	.....	
42,000	.19	.....	
44,000	.20	.....	
46,000	.20	.....	
48,000	.21	.....	
50,000	.21	.....	
52,000	.21	.....	
54,000	.22	.....	
56,000	.23	.....	
58,000	.24	.....	
60,000	.25	.....	
62,000	.27	.....	
64,000	.28	.....	
66,000	.29	.....	
68,000	.30	.....	
70,000	.31	.01	
72,000	.34	.....	
74,000	.39	.....	
75,000	.40	.....	
76,000	.42	.....	
77,000	.45	.....	
78,000	.49	.....	
79,000	.51	.....	
80,000	.54	.19	
82,000	.61	.....	
84,000	.69	.....	
86,000	.77	.....	
88,000	.83	.....	
90,000	.95	.51	
92,000	1.01	.....	
94,000	1.10	.....	
96,000	1.21	.....	
98,000	1.35	.....	
100,000	1.47	.....	
102,000	1.58	.....	
104,000	1.69	.....	
110,000	2.11	.....	
120,000	3.09	.....	
130,000	4.68	.....	
132,000	5.10	.....	Maximum load applied.

Rail deflected until space in the testing fixture was exhausted. The test was then discontinued, the rail not fractured.

TENSILE TESTS OF SPECIMENS FROM HEADS OF TREATED AND UNTREATED STEEL RAILS FROM THE BOSTON ELEVATED RAILWAY COMPANY.

Description.	Diameter.	Sectional area.	Elastic limit.		Tensile strength.		Elongation in 2 inches.		Diameter at fracture.	Contraction of area.	Elongation of inch sections.		Appearance of fracture.
			Total.	Per sq. inch.	Total.	Per sq. inch.							
	Inch.	*Sq. in.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Inch.*	*Per ct.*	*Inch.*	*Per ct.*	"	"	
Untreated	.505	.20	11,400	57,000	23,400	117,000	.37	18.5	.41	34.0	.20*	.17*	Silky and granular.
Treated	.505	.20	16,800	84,000	29,100	145,500	.17	8.5	.48	9.5	.08	.09	Granular.

TESTS FOR HARDNESS.

Tests for hardness were made by means of a pyramidal indenting tool. The relative hardness is taken inversely as the amount of metal displaced by the indenting tool under a given pressure.

In these observations the cuts of the indenting tool were made with a pressure of 10,000 pounds. The locations of the cuts on the rails and relative hardness of the metal are shown as follows:

TREATED RAIL.

Location of the cut of the indenting tool.	Relative hardness.
On head of rail, running surface	69.12
	45.64
Do	66.89
End of head	38.60
Do	38.34
End of web	33.59
End of base	22.52
Do	20.14

UNTREATED RAIL.

Location of cut of indenting tool.	Relative hardness
On head of rail, running surface	27.32
Do	26.99
Do	25.43
End of head	23.84
Do	26.35
End of web	23.98
End of base	26.20
Do	26.67

STEEL RAILS.

Tensile tests of steel plates from the base and web of a section of railroad rail; material furnished by Mr. P. H. Dudley.

Specimen from—	Dimensions. Width.	Dimensions. Thickness.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation in 8 inches.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Inches.	*Inch.*	*Sq. in.*	*Pounds.*	*Pounds.*	*Per ct.*	*Per ct.*	" " " "	
Base.....	1.501	.481	.722	66,500	121,740	13.9	20.2	.11, .12, .19*, .23* .14, .12, .11, .09	Fine granular, radiating from a point on surface of plate.
Web.....	1.001	.467	.467	66,200	118,420	14.2	19.1	.10, .14, .24*, .15 .13, .13, .14, .11	Fine granular, radiating from silky spot at corner of plate.

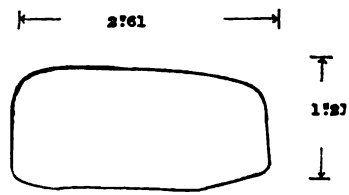
Specimens from web, directly under head. Nos. 1, 2, and 3 annealed; Nos. 4 and 5 in natural state.

Marks.	Diameter.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation in 2 inches.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Inch.	*Sq. in.*	*Pounds.*	*Pounds.*	*Per ct.*	*Per ct.*	" "	
1.....	.505	.20	68,000	119,500	17.5	23.9	.16*, .19*	Silky.
2.....	.505	.20	68,500	123,000	17.0	30.7	.21*, .13	Silky, trace of granulation.
3.....	.505	.20	71,000	120,500	15.5	27.4	.15, .16*	Fine granular, 60 per cent; silky, 40 per cent.
4.....	.505	.20	68,000	119,000	17.5	30.7	.17*, .18*	Silky and granular interspersed.
5.....	.505	.20	67,500	119,500	18.5	34.0	.22*, .15	Silky.

CHEMICAL ANALYSIS OF SPECIMEN NO. 5.

Combined carbon.	Manganese.	Sulphur.	Phosphorus.
.42	.92	.100	.070

TRANSVERSE TESTS OF RAIL HEAD.



Top of head on the tension side.
Ends supported 20 inches apart; loaded at the middle.
Ultimate strength, total, 13,000 pounds.

SECOND SPECIMEN.

Top of head on the tension side.
Ends supported 11 inches apart; loaded at the middle.
Ultimate strength, total, 17,000 pounds.

THIRD SPECIMEN.

Top of head on the tension side.
Ends supported 7 inches apart; loaded at the middle.
Ultimate strength, total, 21,000 pounds.

Appearance of fractures, granular, radiating from a dark-colored spot about 1″×″.2, at upper inside corner of head. These dark-colored spots indicate the presence of incipient cracks which had penetrated the metal of the head, extending downward from the running surface of the rail.

TENSILE TEST OF METAL FROM ONE OF THE FRAGMENTS AFTER THE TRANSVERSE TEST.

Stem ″.505 diameter, by 2″ long.

Elastic limit per square inch	pounds..	62,500
Tensile strength per square inch	do....	118,000
Elongation	per cent..	17.5
Contraction of area	do....	34
Elongation of inch sections		″.21*,″.14
Appearance of fracture	silky and fine granular metal interspersed.	

The running surface of the head of the rail was roughened during service in the track. The short cracks in the metal of the head, which appear as dark-colored spots on the surface of the transverse fractures, seem to have resulted from the service conditions which accompanied and followed the roughening and flow of the surface metal.

The accompanying photographs show the appearance of the running surface and the dark spots on the fractures of transverse tests.

PHOTOGRAPH OF RUNNING SURFACE OF HEAD OF STEEL RAIL.

CAMPBELL ART CO
ELIZABETH, N J.

PHOTOGRAPH OF TRANSVERSE FRACTURES OF HEAD OF STEEL RAIL.

CAMPBELL ART CO.
ELIZABETH, N. J.

HARMET STEEL INGOT.

HARMET STEEL INGOT.

NICKEL-STEEL INGOT, FLUID COMPRESSED BY THE HARMET PROCESS.

The ingot was cast in March, 1905, at the Oberbilker Steel Works, Düsseldorf, Germany. Its weight was 33,550 pounds, and it had the following approximate composition:

Carbon	.19
Manganese	.98
Nickel	3.30
Phosphorus	.032

The casting data were:

	H.	m.
Began pouring the metal	12	4
Began fluid compression	12	22
End of fluid compression	5	40
Mold removed	6	5
Interval, commencement of pouring until fluid compression began		18
Duration of fluid compression	5	18
Commencement of pouring until removal of mold	6	1

Briefly described, the Harmet process of fluid compression consists of subjecting the metal, immediately after casting, to radial compression and longitudinal flow, which is accomplished by forcing the metal along a tapering mold, from the larger toward the smaller end. Two hydraulic pistons are used, one below and one above the mold. The lower and larger end of the mold is made with parallel sides for a distance, this portion being fitted with a plunger, which is supported by the lower piston. After pouring the metal, the smaller end of the mold is closed by means of the top piston. The lower piston is now brought into action, forcing the metal upward against the top piston, and at the same time an inward, radial compression of the ingot occurs, caused by the tapering shape of the mold. There is a graduated application of pressure with the lower piston, the full pressure available being applied only when approaching the end of the interval in which the ingot remains in the mold. The advance of the ingot along the mold, however, is more rapid during the early stages after pouring than at the close of the operation. The ingot is kept under pressure until the temperature has dropped to about 1,500° F., when the lower piston is retracted and the ingot then pushed down and freed from the sides of the mold by means of the top piston.

In the examination and tests of this ingot specimen slices were taken diametrically from the upper and lower halves, the upper one being taken out at right angles to the lower one. There was also a transverse slice from one-half of the ingot at the middle of its length. From these slices 126 tensile specimens have been prepared and tested. Of this number 92 were tested in the natural state of the ingot, 30 were annealed, and 4 were forged and annealed.

The specimens were taken out in general directions longitudinally and transversely, with reference to the axis of the ingot. Some closely followed these general directions, while others were parallel and at right angles, respectively, to the columnar structure shown by the metal of the ingot, and which made with the sides an average angle of about 16° with a normal plane.

Photograph No. 1 is a view of the slice from the upper half of the ingot. The columnar structure of the ingot is shown by the light-colored lines which slope upward from each side toward the center of the slice. At the dome-shaped top corresponding lines are found normal to the curved surface. The upward slope of these columnar lines is taken as evidence of the greater longitudinal flow of the successive layers of metal in passing from the sides of the ingot toward the center, as it occurred during the process of fluid compression.

There were structural defects present, distributed generally throughout the slice—short lines or streaks where the continuity of the metal was impaired or lacking. These lines of structural unsoundness followed courses parallel to the lines of columnar structure. The surface of this slice presented 135 such lines, in lengths up to 1⅞ inches. Photograph No. 2 shows the longest one of these. A similar appearance characterized the slice from the lower half of the ingot.

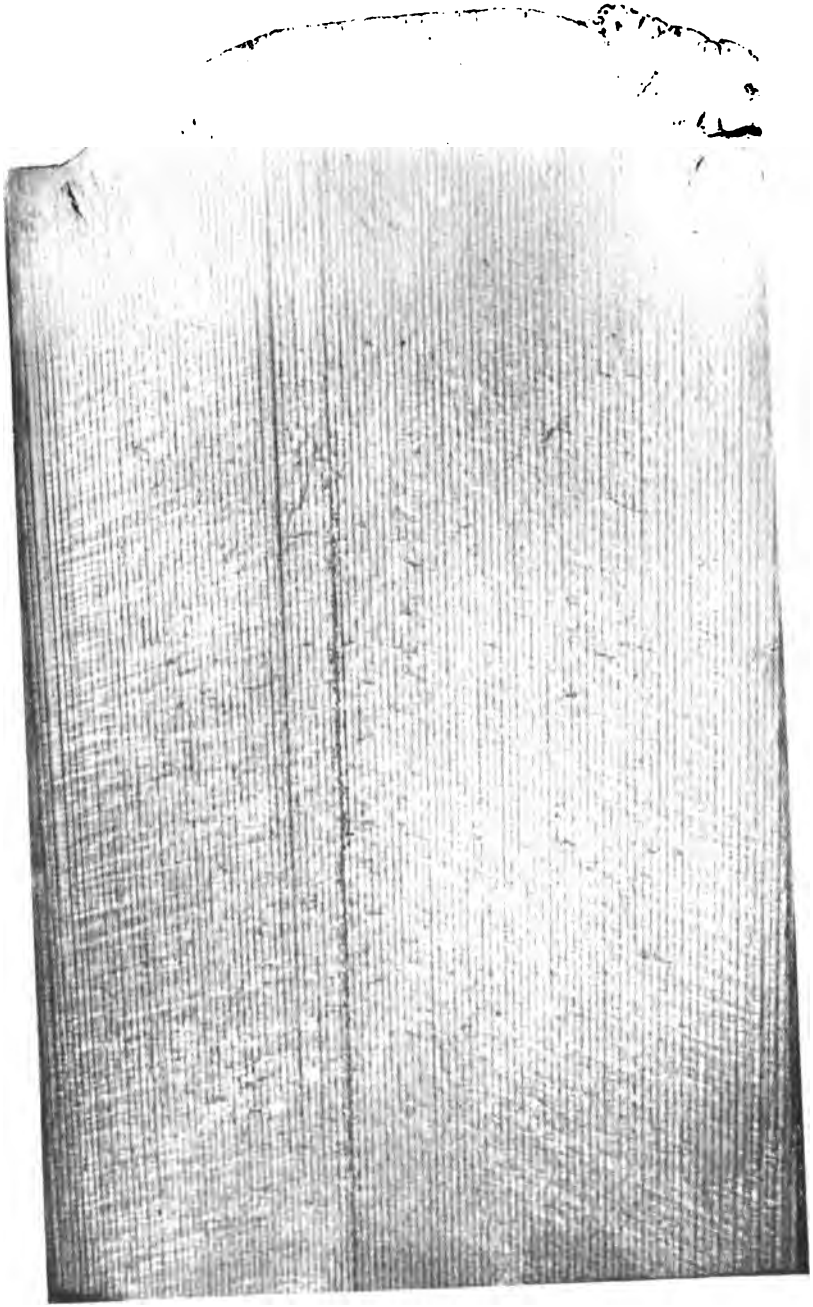
Tensile specimens which were taken parallel to the columnar structure were, in general, superior to those which were taken crosswise. The lines of structural unsoundness developed into open cracks in the tension tests, which made their appearance under comparatively early loads, and located the place of final rupture. Specimens which had these defects parallel, or nearly so, to their stems gave results above those in which the defects were more nearly normal to the direction of the pulling loads.

Accompanying the details of the tests are photographs showing cracks which developed during the progress of testing, and a specimen in which the columnar structure of the ingot is shown by oblique lines across its stem. These lines, which were masked by the finishing cuts in the lathe, were brought into prominence by tensile stresses causing permanent set of the metal. About 60 per cent of the tensile specimens displayed cracks in their stems after testing, representing structural defects in the ingot.

Annealing the steel modified the shape of the stress-strain curve, and usually brought about a well-defined elastic limit. In the natural state of the ingot there was a progressive development of sets, which left the elastic limit vague and indefinite. No direct beneficial influence on the structural defects of the ingot was traceable to the process of annealing.

Specimens which were taken from the slices immediately below the surface of the ingot generally displayed high tensile strength.

The four test pieces which were forged down under the hammer and annealed gave results but little higher in tensile strength than the highest untreated specimen, but with a greater display of elongation and contraction of area.



NO. 1.

HARMET STEEL INGOT.

PHOTOGRAPH OF SLICE FROM UPPER HALF OF INGOT, SHOWING COLUMNAR STEEL TUBE AND SHORT LINES OF CRUCIBLE UNSOUNDNESS.

NO. 2.

HARMET STEEL INGOT.

PHOTOGRAPH OF PRINCIPAL LINE OF STRUCTURAL UNSOUNDNESS IN SLICE FROM UPPER HALF OF INGOT.

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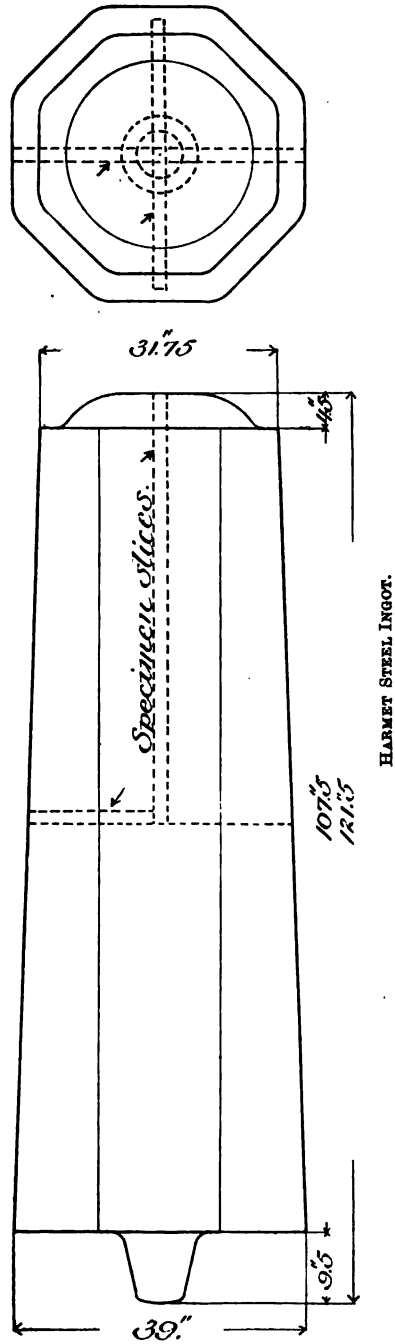
ELIZABETH N J



HARMET STEEL INGOT.

TENSILE TESTS OF SPECIMENS FROM HARMET STEEL INGOT.

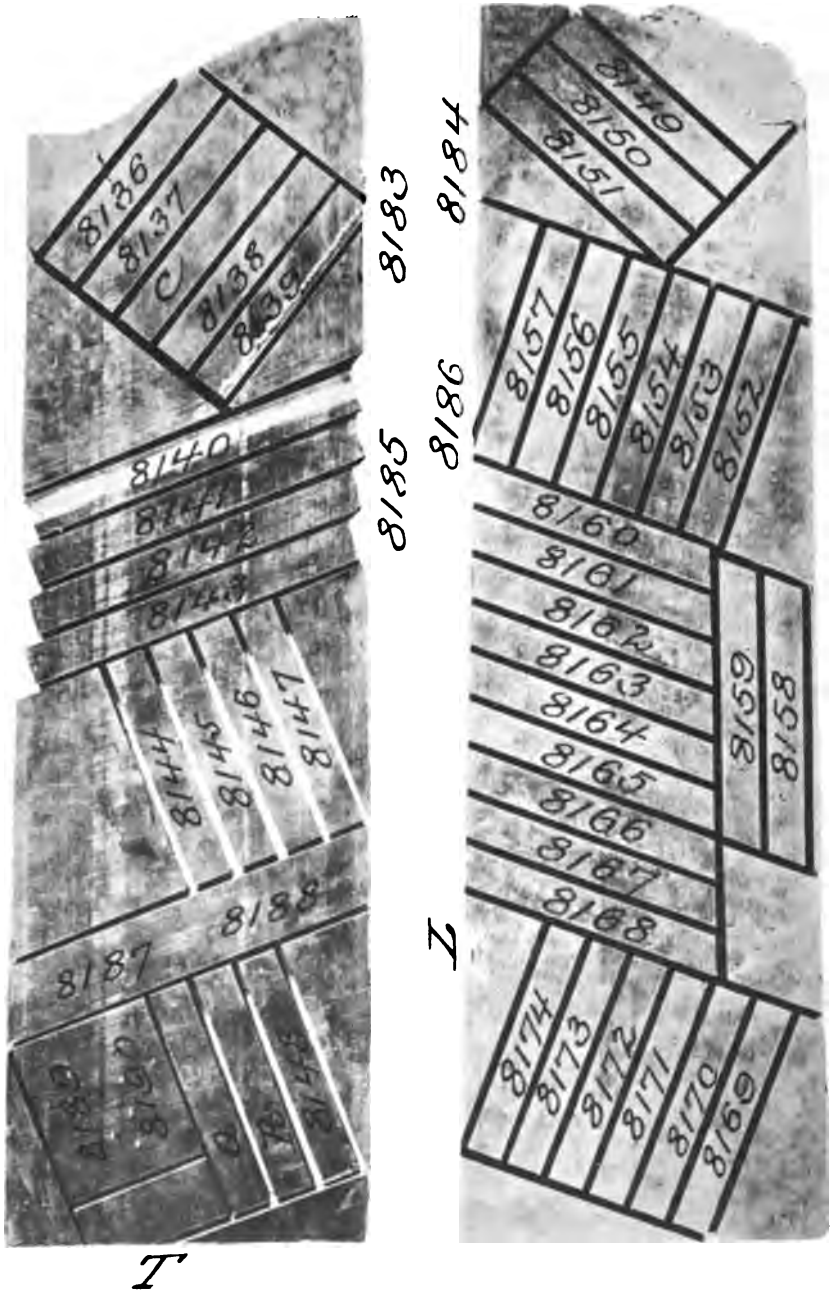
SLICE FROM UPPER HALF.

No. 8136.

Marks, A.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.
A crack existed in the stem prior to testing, near middle of length.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load. Gauged length established on side of stem opposite initial crack.
5,000	.0006	.....	
10,000	.0016	0.	
11,000	.0019	.....	
12,000	.0021	.....	
13,000	.0023	.....	
14,000	.0025	.....	
15,000	.0027	− .0002	
16,000	.0029	.....	
17,000	.0031	.....	
18,000	.0032	.....	
19,000	.0034	.....	
20,000	.0036	− .0003	
21,000	.0037	.....	
22,000	.0039	.....	
23,000	.0041	.....	
24,000	.0043	.....	
25,000	.0045	− .0004	
26,000	.0048	.....	
27,000	.0050	.....	
28,000	.0052	.....	
29,000	.0055	.....	
30,000	.0058	− .0004	
31,000	.0061	.....	
32,000	.0065	.....	
32,600	.....	.....	Tensile strength.
0	.03	.....	=0.5 per cent.

Elongation of inch sections, 0″, 0″, 0″, ″.03*, 0″, 0″.
Contraction of area, inappreciable.
Position of fracture, near middle of length.
Appearance of fracture, granular and columnar, 70 per cent; dark brown, initially cracked portion, 30 per cent.

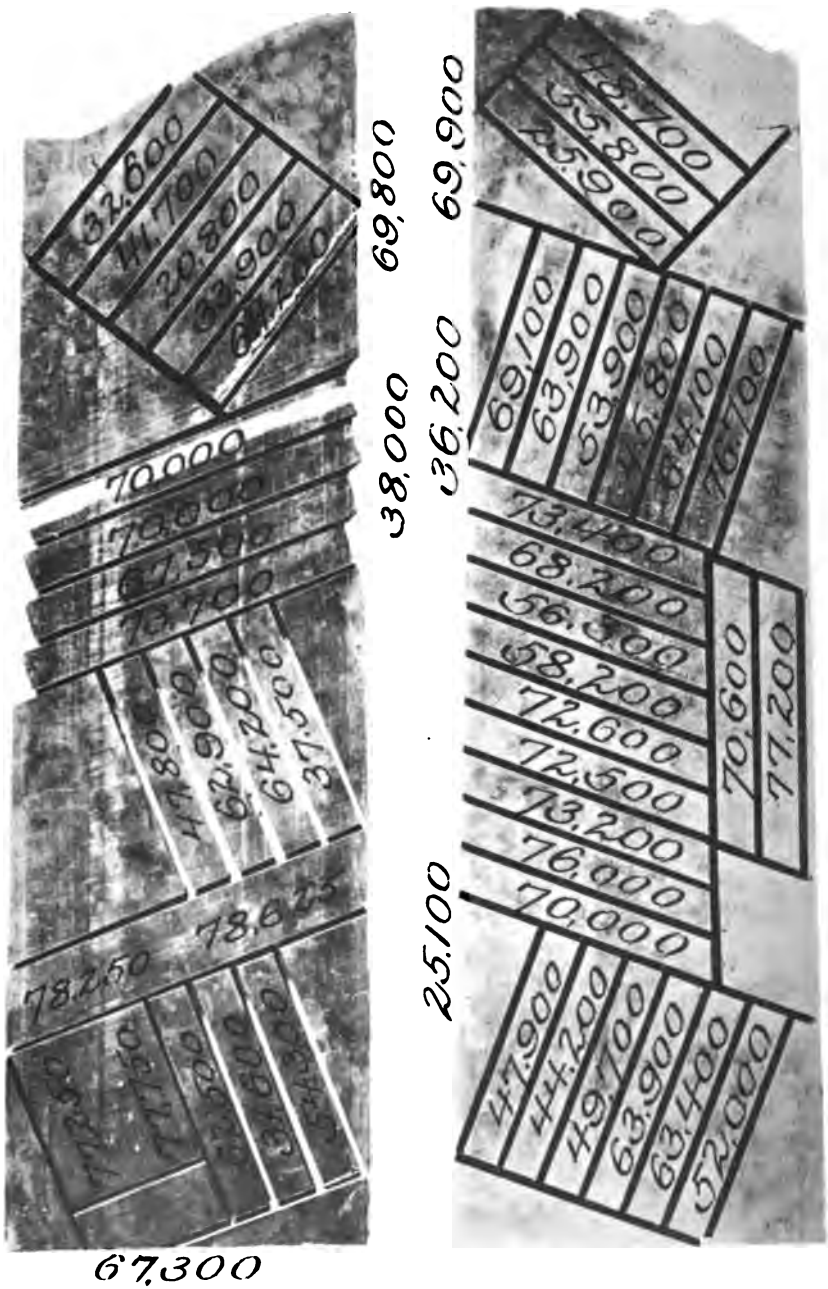


NO. 3.

HARMET STEEL INGOT.

POSITIONS AND TEST NUMBERS OF SPECIMENS IN SLICE FROM UPPER HALF OF INGOT.

CAMPBELL ART CO.



NO. 4.

HARMET STEEL INGOT.

TENSILE STRENGTH OF SPECIMENS FROM SLICE FROM UPPER HALF OF INGOT.

No. 8137.

Marks, B.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0001	.....	
4,000	.0005	.....	
6,000	.0009	.....	
8,000	.0013	.....	
10,000	.0019	0.	
12,000	.0023	.....	
14,000	.0028	.....	
16,000	.0033	.....	
18,000	.0037	.....	
20,000	.0041	0.	
22,000	.0045	.....	
24,000	.0050	.....	
26,000	.0055	.....	
28,000	.0061	.....	
30,000	.0068	.0001	
32,000	.0074	.....	
34,000	.0083	.....	
36,000	.0090	.....	
38,000	.0104	.0020	Snapping sound.
40,000	.01+	.....	
41,700	.....	.....	Tensile strength.
0	.03	.....	=0.5 per cent.

Elongation of inch sections, 0″, 0″, 0″, ″.03*, 0″, 0″ .
Contraction of area, inappreciable.
Position of fracture, near middle of length.
Appearance of fracture, columnar, dendritic.

No. 8138.

Marks, D.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0002	.....	
4,000	.0005	.....	
6,000	.0010	.....	
8,000	.0014	.....	
10,000	.0019	0.	
12,000	.0024	.....	
14,000	.0027	.....	
16,000	.0031	.....	
18,000	.0035	.....	
20,000	.0040	0.	
22,000	.0045	.....	
24,000	.0050	.....	
26,000	.0055	.....	
28,000	.0062	.....	
30,000	.0069	.0005	
32,000	.0079	.....	
33,900	.....	.....	Tensile strength.
0	.03	.....	=0.5 per cent.

Elongation of inch sections, 0″, 0″, 0″, 0″, ″.03*, 0″.
Position of fracture, 1″.75 from the neck.
Contraction of area, inappreciable.
Appearance of fracture, coarse granular, 60 per cent; columnar, dendritic, 40 per cent.

No. 8139.

Marks, E.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
2,000	.0001	.....	
4,000	.0005	.....	
6,000	.0007	.....	
8,000	.0011	.....	
10,000	.0015	0.	
12,000	.0020	.....	
14,000	.0024	.....	
16,000	.0028	.....	
18,000	.0031	.....	
20,000	.0038	−.0001	
22,000	.0044	.....	
24,000	.0048	.....	
26,000	.0054	.....	
28,000	.0059	.....	
30,000	.0064	.0001	
32,000	.0071	.....	
34,000	.0078	.....	
36,000	.0085	.....	
38,000	.0095	.....	
40,000	.0105	.0020	
42,000	.01+	.....	
44,000	.01+	.....	
46,000	.02	.....	
48,000	.02	.....	
50,000	.02	.....	
52,000	.03	.....	
54,000	.04	.....	
55,000	.05	.....	
57,000	.06	.....	
59,000	.07	.....	
62,000	.11	.....	
64,200	.....	.....	Tensile strength.
0	.16	.....	=2.7 per cent.

Elongation of inch sections, ″.01, ″.03, ″.02, ″.02, ″.06*, ″.02.
Diameter at fracture, 1″.10; area, .95 square inch.
Contraction of area, 5 per cent.
Position of fracture, 1″.10 from the neck.
Appearance of fracture, coarse granular and flaky. Opened cracks in stem.

No. 8140.

Marks, F.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.
Length of stem, 11″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0009	.....	
10,000	.0018	0.	
15,000	.0033	.....	
18,000	.0044	.....	
20,000	.0050	−.0001	
25,000	.0071	.....	
28,000	.0082	.....	
30,000	.0089	0.	
32,000	.0108	.....	
35,000	.0114	.....	
36,000	.0120	.....	
37,000	.0128	.....	
38,000	.0134	.....	
39,000	.0141	.....	
40,000	.0155	.0032	
41,000	.0163	.....	
42,000	.0172	.....	
43,000	.0185	.....	
44,000	.0200	.....	
45,000	.0217	.0064	
46,000	.0238	.....	
47,000	.0252	.....	
48,000	.0281	.....	
49,000	.0317	.....	
50,000	.0360	.0181	
52,000	.0465	.....	
54,000	.0690	.0436	
56,000	.10	.....	
58,000	.15	.....	
60,000	.20	.....	
62,000	.24	.....	
64,000	.31	.....	
66,000	.38	.....	
68,000	.47	.....	
70,000	.....	.....	Tensile strength.
0	.59	.....	=5.9 per cent.

Elongation of inch sections, ″.05, ″.05, ″.05, ″.07, ″.09*, ″.06, ″.05, ″.07, ″.04, ″.06.
Diameter at fracture, 1″.08; area, .92 square inch.
Contraction of area, 8 per cent.
Position of fracture, 4″.98 from the neck.
Appearance of fracture, coarse granular, flaky.

No. 8141.

Marks, G.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.
Length of stem, 11″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0013	.....	
10,000	.0031	0.	
20,000	.0069	0.	
30,000	.0108	.0001	
31,000	.0112	.....	
32,000	.0118	.....	
33,000	.0121	.....	
34,000	.0128	.....	
35,000	.0131	.0009	
36,000	.0140	.....	
37,000	.0145	.....	
38,000	.0150	.....	
39,000	.0158	.....	
40,000	.0167	.0025	
41,000	.0178	.....	
42,000	.0188	.....	
43,000	.0205	.....	
44,000	.0217	.....	
45,000	.0232	.0069	
46,000	.0250	.....	
47,000	.0267	.....	
48,000	.0283	.....	
49,000	.0310	.....	
50,000	.0368	.0183	
52,000	.0440	.....	
54,000	.0630	.0423	
56,000	.11	.....	
58,000	.15	.....	
60,000	.20	.....	
62,000	.25	.....	
64,000	.32	.....	
66,000	.39	.....	
68,000	.50	.....	
70,000	.....	.....	Tensile strength.
0	.60	.....	=6 per cent.

Elongation of inch sections, ″.05, ″.05, ″.06, ″.06, ″.06, ″.05, ″.07, ″.05, ″.09*, ″.06.
Diameter at fracture, 1″.09; area, .93 square inch.
Contraction of area, 7 per cent.
Position of fracture, 2″.28 from the neck.
Appearance of fracture, coarse granular, flaky.

No. 8142.

Marks, H.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.
Length of stem, 11″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0012	.....	
10,000	.0031	0.	
20,000	.0069	0.	
30,000	.0108	.0001	
31,000	.0112	.....	
32,000	.0117	.....	
33,000	.0121	.....	
34,000	.0128	.....	
35,000	.0131	.0010	
36,000	.0140	.....	
37,000	.0146	.....	
38,000	.0152	.....	
39,000	.0160	.....	
40,000	.0170	.0028	
41,000	.0183	.....	
42,000	.0190	.....	
43,000	.0200	.....	
44,000	.0217	.....	
45,000	.0240	.0076	
46,000	.0260	.....	
47,000	.0278	.....	
48,000	.0310	.....	
49,000	.0345	.....	
50,000	.0390	.0206	
52,000	.0506	.....	
54,000	.0700	.0496	
56,000	.13	.....	
58,000	.17	.....	
60,000	.21	.....	
62,000	.27	.....	
64,000	.33	.....	
66,000	.40	.....	
67,500	.....	.....	Tensile strength.
0	.42	.....	=4.2 per cent.

Elongation of inch sections, ″.04, ″.03, ″.04, ″.06, ″.07*, ″.03, ″.04, ″.04, ″.05, ″.02.
Diameter at fracture, 1″.10; area, .95 square inch.
Contraction of area, 5 per cent.
Position of fracture, 4″.7 from the neck.
Appearance of fracture, coarse granular, flaky.

No. 8143.

Marks, I.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.
Length of stem, 11″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0013	.....	
10,000	.0032	0.	
20,000	.0070	0.	
30,000	.0109	0.	
31,000	.0112	.....	
32,000	.0118	.....	
33,000	.0121	.....	
34,000	.0128	.....	
35,000	.0132	.0009	
36,000	.0139	.....	
37,000	.0146	.....	
38,000	.0151	.....	
39,000	.0160	.....	
40,000	.0169	.0025	
41,000	.0178	.....	
42,000	.0188	.....	
43,000	.0199	.....	
44,000	.0213	.....	
45,000	.0230	.0071	
46,000	.0253	.....	
47,000	.0274	.....	
48,000	.0300	.....	
49,000	.0330	.....	
50,000	.0370	.0187	
52,000	.0482	.....	
54,000	.0700	.0490	
56,000	.12	.....	
58,000	.15	.....	
60,000	.21	.....	
62,000	.26	.....	
64,000	.30	.....	
66,000	.40	.....	
68,000	.48	.....	
70,000	.59	.....	
72,000	.83	.....	
73,700	.....	.....	Tensile strength.
0	1.12	.....	=11.2 per cent.

Elongation of inch sections, ″.08, ″.09, ″.10, ″.12, ″.11, ″.12, ″.17*, ″.12, ″.11, ″.10.

Diameter at fracture, 1″.04; area, .85 square inch.

Contraction of area, 15 per cent.

Position of fracture, 4″.89 from the neck.

Appearance of fracture, coarse granular, flaky. Opened longitudinal cracks in stem.

No. 8144.

Marks, J.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0007	.....	
10,000	.0018	0.	
15,000	.0030	.....	
20,000	.0040	0.	
25,000	.0050	.....	
30,000	.0062	0.	
31,000	.0065	.....	
32,000	.0068	.....	
33,000	.0071	.....	
34,000	.0073	.....	
35,000	.0076	.0002	
36,000	.0079	.....	
37,000	.0082	.....	
38,000	.0085	.....	
39,000	.0090	.....	
40,000	.0095	.0010	
41,000	.0103	.....	
42,000	.0111	.....	
43,000	.0118	.....	
44,000	.0126	.....	
45,000	.0144	.0044	
46,000	.0162	.....	
47,000	.0187	.....	
47,800	.....	.....	Tensile strength.
0	.03	.....	=0.5 per cent.

Elongation of inch sections, 0″, 0″, 0″, ″.01, 0″, ″.02*.
Contraction of area, inappreciable.
Position of fracture, 1″ from the neck.
Appearance of fracture, coarse granular, brilliant facets.
Fractured across stem partly on two planes, between which the metal presented a columnar, dendritic appearance.

No. 8145.

Marks, K.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0006	.....	
10,000	.0017	0.	
15,000	.0029	.....	
20,000	.0040	0.	
25,000	.0051	.....	
30,000	.0064	0.	
31,000	.0067	.....	
32,000	.0070	.....	
33,000	.0072	.....	
34,000	.0075	.....	
35,000	.0079	.0005	
36,000	.0083	.....	
37,000	.0086	.....	
38,000	.0090	.....	
39,000	.0094	.....	
40,000	.0100	.0015	
41,000	.0106	.....	
42,000	.0111	.....	
43,000	.0118	.....	
44,000	.0124	.....	
45,000	.0133	.0036	
50,000	.03	.....	
55,000	.05	.....	
60,000	.11	.....	
62,900	.....	.....	Tensile strength.
0	.16	.....	=2.7 per cent.

Elongation of inch sections, ″.01, ″.03, ″.07*, ″.02, ″.01, ″.02.
Diameter at fracture, 1″.11; area, .97 square inch.
Contraction of area, 3 per cent.
Position of fracture, 2″.7 from the neck.
Appearance of fracture, coarse granular, brilliant facets.
Opened oblique cracks in two places, at one of which fracture occurred.

No. 8146.

Marks, L.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0006	.....	
10,000	.0016	0.	
15,000	.0027	.....	
20,000	.0039	0.	
25,000	.0050	.....	
30,000	.0062	0.	
31,000	.0065	.....	
32,000	.0069	.....	
33,000	.0071	.....	
34,000	.0073	.....	
35,000	.0076	.0005	
36,000	.0083	.....	
37,000	.0085	.....	
38,000	.0089	.....	
39,000	.0093	.....	
40,000	.0100	.0015	
41,000	.0105	.....	
42,000	.0110	.....	
43,000	.0115	.....	
44,000	.0124	.....	
45,000	.0132	.0038	
46,000	.0142	.....	
47,000	.0154	.....	
48,000	.0164	.....	
49,000	.0176	.....	
50,000	.0199	.0091	
64,200	.....	.....	Tensile strength.
0	.12	.....	=2 per cent.

Elongation of inch sections, ″.01, ″.02, ″.03, ″.02, ″.02, ″.02.
Contraction of area, inappreciable.
Position of fracture, at neck, outside the gauged length.
Appearance of fracture, irregular, coarse granular.

No. 8147.

Marks, M.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0008	.....	
10,000	.0019	0.	
15,000	.0030	.....	
20,000	.0040	0.	
25,000	.0052	.....	
30,000	.0066	.0003	
31,000	.0070	.....	
32,000	.0076	.....	
33,000	.0080	.....	
34,000	.0085	.....	
35,000	.0093	.0015	
36,000	.0102	.....	
37,000	.0110	.....	
37,500	.....	.....	Tensile strength.
0	.04	.....	=0.7 per cent.

Elongation of inch sections, 0″, 0″, ″.01, 0″, ″.03*, 0″.
Contraction of area, inappreciable.
Position of fracture, 1″.9 from the neck.
Appearance of fracture, coarse granular, 60 per cent; dark brown, vesicular patch, 40 per cent.

No. 8148.

Marks, S.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0008	.....	
10,000	.0020	0.	
15,000	.0031	.....	
20,000	.0043	0.	
25,000	.0055	.....	
30,000	.0070	.0005	
31,000	.0075	.....	
32,000	.0078	.....	
33,000	.0080	.....	
34,000	.0084	.....	
35,000	.0090	.0014	
36,000	.0095	.....	
37,000	.0100	.....	
38,000	.0105	.....	
39,000	.0110	.....	
40,000	.0117	.0030	
41,000	.0127	.....	
42,000	.0139	.....	
43,000	.0144	.....	
44,000	.0155	.....	
45,000	.0168	.0068	
46,000	.0188	.....	
47,000	.0211	.0105	
54,300	.....	.....	Tensile strength.
0	.06	.....	−1 per cent.

Elongation of inch sections, 0″, ″.01, ″.03*, ″.01, 0″, ″.01.
Contraction of area, inappreciable.
Position of fracture, 2″.48 from the neck.
Appearance of fracture, coarse granular, flaky.

No. 8149.

Marks, 1.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0010	0.	
10,000	.0021	0.	
15,000	.0031	0.	
20,000	.0041	0.	
25,000	.0052	0.	
30,000	.0063	0.	
31,000	.0065	.....	
32,000	.0069	.....	
33,000	.0071	.....	
34,000	.0074	.....	
35,000	.0079	.0005	
36,000	.0082	.....	
37,000	.0086	.....	
38,000	.0090	.....	
39,000	.0095	.....	
40,000	.0102	.0019	
41,000	.0112	.....	
42,000	.0119	.....	
43,000	.0128	.....	
44,000	.0140	.....	
45,000	.0157	.0061	
47,000	.02	.....	
48,700	.....	.....	Tensile strength.
0	.08	.....	=1.3 per cent.

Elongation of inch sections, ″.05*, ″.01, ″.01, ″.01, 0″, 0″.
Contraction of area, inappreciable.
Position of fracture, ″.65 from the neck.
Appearance of fracture, coarse granular, flaky. Dark brown spot ″.3 by ″.8 on fractured surface.

No. 8150.

Marks, 2.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.
Annealed specimen.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0020	0.	
15,000	.0030	0.	
20,000	.0040	0.	
25,000	.0050	0.	
30,000	.0060	0.	
31,000	.0063	.....	
32,000	.0065	.....	
33,000	.0067	.....	
34,000	.0069	.....	
35,000	.0072	0.	
36,000	.0074	.....	
37,000	.0076	.....	
38,000	.0079	.....	
39,000	.0081	.....	
40,000	.0083	0.	
41,000	.0085	.....	
42,000	.0087	.....	
43,000	.0089	.....	
44,000	.0091	.....	
45,000	.0094	0.	
46,000	.0096	.....	
47,000	.0098	.....	
48,000	.0100	.....	
49,000	.0103	.....	
50,000	.0106	.0002	
52,000	.02+	.....	
53,000	.11	.....	
54,000	.13	.....	
55,000	.15	.....	
55,800	.....	.....	Tensile strength.
0	.21	.....	=3.5 per cent.

Elongation of inch sections, ″.03, ″.02, ″.05, ″.07*, ″.02, ″.02.
Diameter at fracture, 1″.11; area, .97 square inch.
Contraction of area, 3 per cent.
Position of fracture, at middle of stem.
Appearance of fracture, gray, columnar, vesicular. Dark brown spot, ″.2 by ″.4.

No. 8151.

Marks, 3.
Diameter, 1″.12.
Sectional area, 1 square inch.
Gauged length, 6″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0008	.....	
10,000	.0018	0.	
15,000	.0030	.....	
20,000	.0041	0.	
25,000	.0060	.0005	
25,900	.....	.....	Tensile strength.

Elongation after fracture, inappreciable.
Contraction of area, inappreciable.
Position of fracture, at neck and in head.
Appearance of fracture, coarse granular, 50 per cent; dark brown, columnar, and vesicular, 50 per cent.

No. 8152.

Marks, 4.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.
Annealed specimen.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0007	.....	
10,000	.0016	0.	
15,000	.0027	.....	
20,000	.0038	— .0002	
25,000	.0047	.....	
30,000	.0058	— .0004	
35,000	.0068	— .0005	
40,000	.0079	— .0005	
41,000	.0081	.....	
42,000	.0083	.....	
43,000	.0085	.....	
44,000	.0087	.....	
45,000	.0090	— .0005	
46,000	.0092	.....	
47,000	.0094	.....	
48,000	.0096	.....	
49,000	.0099	.....	
50,000	.0101	— .0004	
54,000	.02	.....	
54,200	.....	.....	Elastic limit.
54,500	.13	.....	
55,000	.15	.....	
56,000	.16	.....	
58,000	.17	.....	
60,000	.20	.....	
62,000	.24	.....	
64,000	.28	.....	
66,000	.31	.....	
68,000	.37	.....	
70,000	.43	.....	
72,000	.52	.....	
74,000	.64	.....	
76,000	.99	.....	
76,700	.....	.....	Tensile strength.
0	1.50	.....	= 25 per cent.

Elongation of inch sections, ″.15, ″.25, ″.49*, ″.26, ″.20, ″.15.
Diameter at fracture, ″.88; area, .61 square inch.
Contraction of area, 39 per cent.
Position of fracture, 3″.35 from the neck.
Appearance of fracture, columnar, vesicular; gray; close resemblance to a silky fracture.

No. 8153.

Marks, 5.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0008	.....	
10,000	.0017	0.	
15,000	.0029	.....	
20,000	.0038	0.	
25,000	.0048	.....	
30,000	.0060	0.	
35,000	.0074	.0003	
36,000	.0078	.....	
37,000	.0080	.....	
38,000	.0085	.....	
39,000	.0089	.....	
40,000	.0092	.0010	
41,000	.0098	.....	
42,000	.0103	.....	
43,000	.0109	.....	
44,000	.0115	.....	
45,000	.0123	.0030	
46,000	.0132	.....	
47,000	.0141	.....	
48,000	.0152	.....	
49,000	.0162	.....	
50,000	.0176	.0072	
52,000	.02	.....	
54,000	.03	.....	
56,000	.04	.....	
58,000	.05	.....	
60,000	.07	.....	
62,000	.10	.....	
64,000	.13	.....	
64,100	.....	.....	Tensile strength.
0	.14	.....	= 2.3 per cent.

Elongation of inch sections, ″.01, ″.05*, ″.03, ″.01, ″.02, ″.02.
Diameter at fracture, 1″.11; area, .97 square inch.
Contraction of area, 3 per cent.
Position of fracture, 1″.6 from the neck.
Appearance of fracture, coarse granular.

No. 8154.

Marks, 6.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.
Annealed specimen.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0008	.....	
10,000	.0019	0.	
15,000	.0030	.....	
20,000	.0041	0.	
25,000	.0052	.....	
30,000	.0063	.0003	
31,000	.0066	.....	
32,000	.0069	.....	
33,000	.0071	.....	
34,000	.0073	.....	
35,000	.0075	.0004	
36,000	.0079	.....	
37,000	.0082	.....	
38,000	.0085	.....	
39,000	.0088	.....	
40,000	.0091	.0007	
41,000	.0095	.....	
42,000	.0104	.....	
43,000	.0111	.....	
44,000	.0136	.....	
45,800	.....	.....	Tensile strength.
0	.10	.....	= 1.7 per cent.

Elongation of inch sections, 0″, 0″, 0″, 0″, ″.10*, 0″.
Diameter at fracture, 1″.10; area, .95 square inch.
Contraction of area, 5 per cent.
Position of fracture, 1″.62 from the neck.
Appearance of fracture, gray, amorphous, 60 per cent; vesicular, 40 per cent. Opened an oblique crack in stem, 1¼″ from place of rupture.

No. 8155.

Marks, 7.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0009	.....	
10,000	.0020	0.	
15,000	.0030	.....	
20,000	.0041	0.	
25,000	.0052	.....	
30,000	.0064	.0003	
31,000	.0068	.....	
32,000	.0071	.....	
33,000	.0075	.....	
34,000	.0078	.....	
35,000	.0082	.0009	
36,000	.0087	.....	
37,000	.0090	.....	
38,000	.0094	.....	
39,000	.0100	.....	
40,000	.0105	.0020	
41,000	.0111	.....	
42,000	.0116	.....	
43,000	.0123	.....	
44,000	.0130	.....	
45,000	.0140	.0044	
46,000	.0152	.....	
47,000	.0163	.....	
48,000	.0175	.....	
49,000	.0192	.....	
50,000	.0210	.0102	
53,900	.....	.....	Tensile strength.
0	.02	.....	=0.3 per cent.

Elongation of inch sections, ″.01*, 0″, 0″, ″.01, 0″, 0″.
Contraction of area, inappreciable.
Position of fracture, at neck.
Appearance of fracture, coarse granular, flaky, 70 per cent; oblique, vesicular surface, 30 per cent.

No. 8156.

Marks, 8.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.
Annealed specimen.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0009	.....	
10,000	.0020	0.	
15,000	.0030	.....	
20,000	.0041	0.	
25,000	.0052	.....	
30,000	.0062	0.	
35,000	.0074	.0001	
40,000	.0085	.0001	
41,000	.0087	.....	
42,000	.0090	.....	
43,000	.0093	.....	
44,000	.0095	.....	
45,000	.0098	.0004	
46,000	.0101	.....	
47,000	.0103	.....	
48,000	.0107	.....	
49,000	.0111	.....	
50,000	.0116	.0013	
51,000	.....	.....	Elastic limit.
54,000	.12	.....	
56,000	.14	.....	
58,000	.18	.....	
60,000	.20	.....	
62,000	.24	.....	
63,900	.....	.....	Tensile strength.
0	.37	.....	=6.2 per cent.

Elongations of inch sections, ″.03, ″.05, ″.04, ″.03, ″.04, ″.18*.
Diameter at fracture, 1″.05; area, .87 square inch.
Contraction of area, 13 per cent.
Position of fracture, ″.8 from the neck.
Appearance of fracture, gray, amorphous. Opened cracks in surface of stem in three places.

No. 8157.

Marks, 9.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	Initial load.
1,000	0.	0.	
5,000	.0008	.....	
10,000	.0019	0.	
15,000	.0029	.....	
20,000	.0040	0.	
25,000	.0052	.....	
30,000	.0066	.0004	
31,000	.0069	.....	
32,000	.0072	.....	
33,000	.0075	.....	
34,000	.0080	.....	
35,000	.0084	.0010	
36,000	.0087	.....	
37,000	.0092	.....	
38,000	.0097	.....	
39,000	.0102	.....	
40,000	.0106	.0023	
41,000	.0116.	.....	
42,000	.0122	.....	
43,000	.0128	.....	
44,000	.0134	.....	
45,000	.0145	.0050	
46,000	.0157	.....	
47,000	.0164	.....	
48,000	.0176	.....	
49,000	.0191	.....	
50,000	.0209	.0102	
52,000	.03	.....	
56,000	.04	.....	
58,000	.06	.....	
60,000	.08	.....	
62,000	.10	.....	
64,000	.12	.....	
66,000	.18	.....	
68,000	.22	.....	
69,100	.....	.....	Tensile strength.
0	.21	.....	=3.5 per cent.

Elongation of inch sections, ″.05, ″.03, ″.04, ″.03, ″.03, ″.03.
Position of fracture, at the neck.
Appearance of fracture, coarse granular, flaky.

No. 8158.

Marks, 10.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.
Annealed specimen.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0008	.....	
10,000	.0018	0.	
15,000	.0028	.....	
20,000	.0039	0.	
25,000	.0050	.....	
30,000	.0060	0.	
35,000	.0071	0.	
40,000	.0081	0.	
45,000	.0092	0.	
48,000	.0099	.....	
49,000	.0103	.....	
50,000	.0105	.0001	
51,000	.0107	.....	
52,000	.0110	.....	
53,000	.0114	.....	
54,000	.0119	.....	
54,800	.....	.....	Elastic limit. Load fell.
49,000	.0221	.....	
49,500	.0235	.....	
50,000	.0260	.....	
51,000	.0480	.....	
52,000	.0865	.....	
54,000	.10	.....	
56,000	.12	.....	
58,000	.15	.....	
60,000	.18	.....	
62,000	.21	.....	
64,000	.25	.....	
66,000	.32	.....	
68,000	.36	.....	
70,000	.44	.....	
72,000	.52	.....	
74,000	.63	.....	
76,000	.81	.....	
77,200	.....	.....	Tensile strength.
0	1.25	.....	= 20.8 per cent.

Elongation of inch sections, ″.17, ″.25, ″.31*, ″.21, ″.17, ″.14.
Diameter at fracture, ″.98; area, .75 square inch.
Contraction of area, 25 per cent.
Position of fracture, 3″.2 from the neck.
Appearance of fracture, silky, oblique.

No. 8159.

Marks, 11.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0008	.....	
10,000	.0018	0.	
15,000	.0029	.....	
20,000	.0040	0.	
25,000	.0050	.....	
30,000	.0061	0.	
35,000	.0073	.0002	
39,000	.0085	.....	
40,000	.0089	.0006	
41,000	.0094	.....	
42,000	.0097	.....	
43,000	.0103	.....	
44,000	.0108	.....	
45,000	.0115	.0021	
46,000	.0123	.....	
47,000	.0131	.....	
48,000	.0140	.....	
49,000	.0151	.....	
50,000	.0169	.0060	
51,000	.0185	.....	
52,000	.0206	.....	
54,000	.03	.....	
56,000	.04	.....	
58,000	.06	.....	
60,000	.08	.....	
62,000	.10	.....	
64,000	.14	.....	Crack visible in surface of stem.
66,000	.17	.....	
68,000	.23	.....	
70,000	.29	.....	
70,600	.....	.....	Tensile strength.
0	.32	.....	—5.3 per cent.

Elongation of inch sections, ″.04, ″.06, ″.09*, ″.04, ″.05, ″.04.
Diameter at fracture, 1″.08; area, .92 square inch.
Contraction of area, 8 per cent.
Position of fracture, 2″.4 from the neck.
Appearance of fracture, coarse granular, 85 per cent; smooth, lustrous, oblique, 15 per cent.

No. 8160.

Marks, 12.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0007	.....	
10,000	.0017	0.	
15,000	.0029	.....	
20,000	.0040	0.	
25,000	.0050	.....	
30,000	.0063	0.	
35,000	.0078	.0004	
36,000	.0082	.....	
37,000	.0085	.....	
38,000	.0089	.....	
39,000	.0093	.....	
40,000	.0098	.0015	
41,000	.0107	.....	
42,000	.0110	.....	
43,000	.0117	.....	
44,000	.0125	.....	
45,000	.0136	.0041	
46,000	.0148	.....	
47,000	.0159	.....	
48,000	.0175	.....	
49,000	.0194	.....	
50,000	.0216	.0106	
52,000	.03	.....	
54,000	.04	.....	
56,000	.06	.....	
58,000	.08	.....	
60,000	.11	.....	
62,000	.14	.....	
64,000	.17	.....	
66,000	.23	.....	
68,000	.28	.....	
70,000	.34	.....	
72,000	.55	.....	
73,400	.....	.....	Tensile strength.
0	.66	.....	=11 per cent.

Elongation of inch sections, ″.09, ″.09, ″.18*, ″.13, ″.10, ″.07.
Diameter at fracture, 1″.05; area, .87 square inch.
Contraction of area, 13 per cent.
Position of fracture, 2″.80 from the neck.
Appearance of fracture, coarse granular.

No. 8161.

Marks, 13.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.
Annealed specimen.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0008	.....	
10,000	.0019	0.	
15,000	.0030	.....	
20,000	.0040	.....	
25,000	.0050	.....	
30,000	.0060	0.	
35,000	.0071	.....	
40,000	.0083	0.	
45,000	.0095	.....	
48,000	.0103	.....	
50,000	.0109	.0003	
51,000	.0112	.....	
52,000	.0116	.....	
53,000	.....	.....	Elastic limit. Load fell.
49,000	.0200	.....	
50,000	.0225	.....	
51,000	.0295	.....	
52,000	.0600	.....	
54,000	.09	.....	
56,000	.14	.....	
58,000	.17	.....	
60,000	.20	.....	
62,000	.22	.....	
64,000	.26	.....	
66,000	.32	.....	
68,000	.39	.....	
68,200	.....	.....	Tensile strength.
0	.50	.....	=8.3 per cent.

Elongation of inch sections, ″.18*, ″.09, ″.05, ″.06, ″.06, ″.06.
Diameter at fracture, 1″.04; area, .85 square inch.
Contraction of area, 15 per cent.
Position of fracture, ″.75 from the neck.
Appearance of fracture, dull silky, oblique. Opened cracks in stem in two places.

No. 8162.

Marks, 14.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0009	.....	
10,000	.0019	0.	
15,000	.0030	.....	
20,000	.0041	.....	
25,000	.0053	.....	
30,000	.0065	.0002	
35,000	.0078	.....	
40,000	.0101	.0017	
41,000	.0110	.....	
42,000	.0115	.....	
43,000	.0123	.....	
44,000	.0130	.....	
45,000	.0142	.0046	
46,000	.0157	.....	
47,000	.0169	.....	
48,000	.0186	.....	
49,000	.0210	.....	
50,000	.0235	.0127	
52,000	.03	.....	
54,000	.05	.....	
56,000	.07	.....	
56,300	.....	.....	Tensile strength.
0	.08	.....	=1.3 per cent.

Elongation of inch sections, ″.01, ″.01, ″.01, ″.01, ″.02*, ″.02.
Contraction of area, inappreciable.
Position of fracture, 1″.3 from the neck.
Appearance of fracture, coarse granular; in part smooth, lustrous, oblique.

No. 8163.

Marks, 15.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.
Annealed specimen.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0008	.....	
10,000	.0019	0.	
15,000	.0030	.....	
20,000	.0041	.....	
25,000	.0052	.....	
30,000	.0062	0.	
35,000	.0073	.....	
40,000	.0084	.....	
45,000	.0096	.....	
48,000	.0104	.....	
49,000	.0107	.....	Elastic limit.
50,000	.0147	.....	Load fell.
48,000	.0165	.....	
49,000	.0206	.....	
50,000	.0254	.0151	
52,000	.05	.....	
54,000	.07	.....	
56,000	.15	.....	
58,000	.19	.....	
58,200	.....	.....	Tensile strength.
0	.28	.....	=4.7 per cent.

Elongation of inch sections, ″.03, ″.03, ″.02, ″.03, ″.04, ″.13*.
Diameter at fracture, 1″.06; area, .88 square inch.
Contraction of area, 12 per cent.
Position of fracture, ″.8 from the neck.
Appearance of fracture, silky, 90 per cent; smooth, lustrous, oblique, 10 per cent.

No. 8164.

Marks, 16.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0009	.....	
10,000	.0020	0.	
15,000	.0030	.....	
20,000	.0041	.....	
25,000	.0052	.....	
30,000	.0066	.0003	
35,000	.0081	.....	
40,000	.0102	.0017	
45,000	.0139	.0044	
48,000	.0180	.....	
50,000	.0223	.0114	
52,000	.03	.....	
54,000	.04	.....	
56,000	.06	.....	
58,000	.08	.....	
60,000	.11	.....	
62,000	.14	.....	
64,000	.18	.....	
66,000	.22	.....	
68,000	.28	.....	
70,000	.36	.....	
72,000	.47	.....	
72,600	.....	.....	Tensile strength.
0	.50	.....	=8.3 per cent.

Elongation of inch sections, ″.07, ″.07, ″.08, ″.14*, ″.08, ″.06.
Diameter of fracture, 1″.07; area, .90 square inch.
Contraction of area, 10 per cent.
Position of fracture, 3″.06 from the neck.
Appearance of fracture, coarse granular. A short longitudinal and a short oblique crack opened at place of rupture.

No. 8165.

Marks, 17.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.
Annealed specimen.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0009	.....	
10,000	.0019	0.	
15,000	.0030	.....	
20,000	.0040	.....	
25,000	.0051	.....	
30,000	.0063	0.	
35,000	.0073	.....	
40,000	.0084	0.	
45,000	.0096	.....	
50,000	.0110	.0004	
51,000	.0113	.....	
52,000	.0116	.....	
53,000	.0121	.....	
53,900	.....	.....	Elastic limit. Load fell.
49,000	.0239	.....	
50,000	.0264	.....	
51,000	.0885	.....	
52,000	.0955	.....	
54,000	.12	.....	
56,000	.14	.....	
58,000	.16	.....	
60,000	.19	.....	
62,000	.22	.....	
64,000	.26	.....	Cracks in sight in stem in three places.
66,000	.30	.....	
68,000	.36	.....	
70,000	.43	.....	
72,000	.53	.....	
72,500	.....	.....	Tensile strength.
0	.71	.....	=11.8 per cent.

Elongation of inch sections, ″.09, ″.09, ″.22*, ″.15, ″.08, ″.08.
Diameter at fracture, 1″.03; area, .83 square inch.
Contraction of area, 17 per cent.
Position of fracture, 3″.37 from the neck.
Appearance of fracture, silky. The stem tore apart progressively from a crack developed by earlier stresses.

No. 8166.

Marks, 18.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0009	.....	
10,000	.0020	0.	
15,000	.0031	.....	
20,000	.0042	.....	
25,000	.0053	.....	
30,000	.0067	.0003	
35,000	.0083	.....	
40,000	.0105	.0020	
42,000	.0119	.....	
44,000	.0135	.....	
45,000	.0149	.0050	
46,000	.0165	.....	
47,000	.0177	.....	
48,000	.0194	.....	
49,000	.0219	.....	
50,000	.0250	.0140	
52,000	.04	.....	
54,000	.05	.....	
56,000	.07	.....	
58,000	.10	.....	
60,000	.13	.....	
62,000	.15	.....	
64,000	.20	.....	
66,000	.26	.....	
68,000	.32	.....	
70,000	.41	.....	
72,000	.59	.....	
73,200	.....	.....	Tensile strength.
0	1.12	.....	= 18.7 per cent.

Elongation of inch sections, ″.11, ″.16, ″.25*, ″.37*, ″.13, ″.10.
Diameter at fracture, ″.90; area, .64 square inch.
Contraction of area, 36 per cent.
Position of fracture, 3″.5 from the neck.
Appearance of fracture, silky, interspersed with granular metal.

No. 8167.

Marks, 19.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.
Annealed specimen.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0009	.....	
10,000	.0020	0.	
15,000	.0030	.....	
20,000	.0041	.....	
25,000	.0051	.....	
30,000	.0063	.....	
35,000	.0073	.....	
40,000	.0085	0.	
45,000	.0097	.....	
48,000	.0105	.....	
50,000	.0111	.0005	
51,000	.0115	.....	
52,000	.0119	.....	
53,000	.0125	.....	
53,800	.....	.....	Elastic limit. Load fell.
48,500	.0238	.....	
49,000	.0245	.....	
50,000	.0285	.....	
51,000	.0860	.....	
52,000	.0950	.0840	
54,000	.11	.....	
56,000	.14	.....	
58,000	.17	.....	
60,000	.20	.....	
62,000	.23	.....	
64,000	.26	.....	Cracks visible on stem. Two longitudinal ones and one oblique crack.
66,000	.32	.....	
68,000	.37	.....	
70,000	.43	.....	
72,000	.52	.....	
74,000	.64	.....	
76,000	.....	.....	Tensile strength.
0	.97	.....	= 16.2 per cent.

Elongation of inch sections, ″.13, ″.32*, ″.14, ″.13, ″.12, ″.13.
Diameter at fracture, ″.98; area, .75 square inch.
Contraction of area, 25 per cent.
Position of fracture, 1″.60 from the neck.
Appearance of fracture, silky. Tore apart in detail, commencing at a crack developed by earlier stresses.

No. 8168.

Marks, 20.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0009	.....	
10,000	.0019	0.	
15,000	.0020	.....	
20,000	.0041	.....	
25,000	.0052	.....	
30,000	.0065	.0002	
35,000	.0080	.....	
40,000	.0103	.0018	
45,000	.0140	.....	
48,000	.0183	.....	
50,000	.0235	.0126	
52,000	.04	.....	
54,000	.05	.....	
56,000	.07	.....	
58,000	.10	.....	
60,000	.12	.....	
62,000	.15	.....	
64,000	.19	.....	
66,000	.23	.....	
68,000	.31	.....	
70,000	.....	.....	Tensile strength.
0	.39	.....	—6.5 per cent.

Elongation of inch sections, ″.06, ″.05, ″.06, ″.06, ″.09*, ″.07*.
Diameter at fracture, 1″.08; area, .92 square inch.
Contraction of area, 8 per cent.
Position of fracture, 1″.45 from the neck.
Appearance of fracture, coarse granular.

No. 8169.

Marks, 21.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0008	.....	
10,000	.0019	0.	
15,000	.0030	.....	
20,000	.0040	.....	
25,000	.0051	.....	
30,000	.0062	0.	
35,000	.0078	.....	
40,000	.0096	.0012	
45,000	.0138	.....	
48,000	.0184	.....	
50,000	.0232	.0124	
52,000	.....	.....	Tensile strength.
0	.04	.....	=0.7 per cent.

Elongation of inch sections, ″.01, 0″, 0″, ″.02*, ″.01, 0″.
Contraction of area, inappreciable.
Position of fracture, 2″.6 from the neck.
Appearance of fracture, smooth, lustrous, 85 per cent; dull brown surface, 15 per cent.

No. 8170.

Marks, 22.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.
Annealed specimen.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0009	.....	
10,000	.0020	0.	
15,000	.0030	.....	
20,000	.0041	.....	
25,000	.0051	.....	
30,000	.0062	.0001	
35,000	.0073	.....	
40,000	.0086	.0002	
45,000	.0101	.....	
48,000	.....	.....	Opened oblique crack in stem.
63,400	.....	.....	Tensile strength.
0	.35	.....	=5.8 per cent.

Elongation of inch sections, ″.03, ″.05, ″.17*, ″.03, ″.03, ″.04.
Diameter at fracture, 1″.03; area, .83 square inch.
Contraction of area, 17 per cent.
Position of fracture, 2″.4 from the neck.
Appearance of fracture, dull gray, silky; in part smooth, oblique. Opened seven cracks in surface of stem.

No. 8171.

Marks, 23.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0009	.....	
10,000	.0020	0.	
15,000	.0030	.....	
20,000	.0041	.....	
25,000	.0052	.....	
30,000	.0064	.0002	
35,000	.0079	.....	
40,000	.0100	.0014	
45,000	.0133	.0039	
50,000	.0219	.0112	Crack opened in stem.
56,000	.05	.....	
60,000	.10	.....	
62,000	.14	.....	
63,900	.....	.....	Tensile strength.
0	.17	.....	—2.8 per cent.

Elongation of inch sections, ″.02, ″.06*, ″.02, ″.02, ″.03, ″.02.
Diameter at fracture, 1″.11; area, .97 square inch.
Contraction of area, 3 per cent.
Position of fracture, 1″.44 from the neck.
Appearance of fracture, granular, flaky, lustrous.

No. 8172.

Marks, 24.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.
Annealed specimen.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0009	.....	
10,000	.0018	0.	
15,000	.0029	.....	
20,000	.0041	.....	
25,000	.0053	.....	
30,000	.0064	.0001	
35,000	.0079	.....	
38,000	.0089	.....	
40,000	.0098	.0014	
41,000	.0109	.....	
42,000	.0121	.....	
43,000	.0136	.....	
44,000	.0177	.....	
45,000	.0223	.0135	Crack visible in stem.
48,000	.04	.....	
49,700	.....	.....	Tensile strength.
0	.16	.....	=2.7 per cent.

Elongation of inch sections, 0″, 0″, ″.15*, ″.01, 0″, 0″.
Diameter at fracture, 1″.04; area, .85 square inch.
Contraction of area, 15 per cent.
Position of fracture, 2″.62 from the neck.
Appearance of fracture, silky, oblique, 85 per cent; smooth, lustrous, 15 per cent.
The lustrous section represented the part at which a crack appeared at 45,000 pounds tension. On this side of the stem the crack was open ″.10 when the other side was in contact.

No. 8173.

Marks, 25.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0009	.....	
10,000	.0019	0.	
15,000	.0030	.....	
20,000	.0041	.....	
25,000	.0054	.....	
30,000	.0069	.0005	
35,000	.0093	.....	
40,000	.0131	.0045	Crack visible in stem.
44,000	.02	.....	
44,200	.....	.....	Tensile strength.
0	.04	.....	=0.7 per cent.

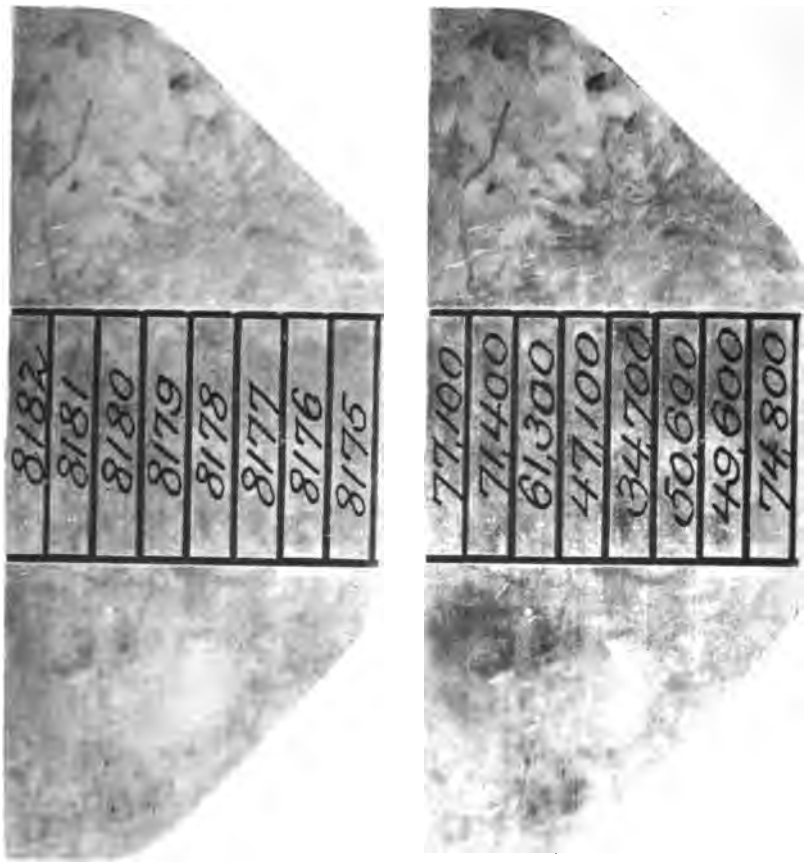
Elongation of inch sections, 0″, ″.04*, 0″, 0″, 0″, 0″.
Contraction of area, inappreciable.
Position of fracture, 1″.6 from the neck.
Appearance of fracture, coarse granular; flaky, lustrous.

No. 8174.

Marks, 26.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.
Annealed specimen.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0008	.....	
10,000	.0020	0.	
15,000	.0031	.....	
20,000	.0043	.....	
25,000	.0054	.....	
30,000	.0065	.0002	
35,000	.0079	.....	
38,000	.0890	.....	
40,000	.0102	.0020	
42,000	.0121	.....	
43,000	.0136	.....	Crack visible in stem.
44,000	.0175	.....	
45,000	.0220	.0128	
47,900	.....	.....	Tensile strength.
0	.10	.....	=1.7 per cent.

Elongation of inch sections, 0″, ″.02, ″.08*, 0″, 0″, 0″.
Diameter at fracture, 1″.07; area, .90 square inch.
Contraction of area, 10 per cent.
Position of fracture, 2″.2 from the neck.
Appearance of fracture, dull gray, silky, 70 per cent; smooth, lustrous, 30 per cent.



NO. 5.

HARMET STEEL INGOT.

POSITION, TEST NUMBERS AND TENSILE STRENGTH OF SPECIMENS FROM TRANSVERSE SECTION FROM MIDDLE OF INGOT.

CAMPBELL ART CO.
ELIZABETH, N. J.

TENSILE TESTS OF SPECIMENS FROM HARMET STEEL INGOT.

TRANSVERSE SLICE FROM MIDDLE OF LENGTH OF INGOT.

No. 8175.

Marks, 27.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0008	.....	
10,000	.0019	0.	
15,000	.0029	.....	
20,000	.0040	.....	
25,000	.0050	.....	
30,000	.0060	0.	
35,000	.0072	.....	
40,000	.0087	.0006	
42,000	.0097	.....	
45,000	.0111	.0022	
48,000	.0149	.....	
50,000	.0190	.0085	
54,000	.04	.....	
56,000	.06	.....	
58,000	.09	.....	
60,000	.11	.....	
62,000	.14	.....	
64,000	.17	.....	
66,000	.20	.....	
68,000	.25	.....	
70,000	.31	.....	
72,000	.39	.....	
74,000	.51	.....	
74,800	.....	.....	Tensile strength.
0	.61	.....	=10.2 per cent.

Elongation of inch sections, ″.09, ″.10, ″.09, ″.10, ″.13*, ″.10.
Diameter at fracture, 1″.06; area, .88 square inch.
Contraction of area, 12 per cent.
Position of fracture, 2″.08 from the neck.
Appearance of fracture, coarse granular, striated.

No. 8176.

Marks, 28.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0008	.....	
10,000	.0018	0.	
15,000	.0029	.....	
20,000	.0040	.....	
25,000	.0050	.....	
30,000	.0061	0.	
35,000	.0074	.....	
38,000	.0085	.....	
40,000	.0099	.0011	
42,000	.0118	.....	
45,000	.0175	.0075	
48,000	.0290	.....	
49,600	.....	.....	Tensile strength.
0	.04	.....	=0.7 per cent.

Elongation of inch sections, 0″, ″.03*, 0″, 0″, ″.01, 0″.
Contraction of area, inappreciable.
Position of fracture, 1″.46 from the neck.
Appearance of fracture, coarse granular, flaky; in part columnar. Opened a crack in stem.

No. 8177.

Marks, 29.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0008	.....	
10,000	.0019	0.	
15,000	.0030	.....	
20,000	.0040	0.	
25,000	.0051	.....	
30,000	.0062	.0001	
35,000	.0074	.....	
38,000	.0084	.....	
40,000	.0094	.0011	
42,000	.0106	.....	
45,000	.0135	.0041	
48,000	.0183	.....	
50,600	.....	.....	Tensile strength.
0	.03	.....	=0.5 per cent.

Elongation of inch sections, ″.02*, 0″, ″.01, 0″, 0″, 0″.
Contraction of area, inappreciable.
Position of fracture, ″.95 from the neck.
Appearance of fracture, granular, flaky; lustrous, striated. Five per cent of surface nearly black in color.

No. 8178.

Marks, 30.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0009	.....	
10,000	.0019	0.	
15,000	.0029	.....	
20,000	.0041	.....	
25,000	.0054	.....	
30,000	.0070	.0004	
34,700	.....	.....	Tensile strength.
0	.03	.....	= 0.5 per cent.

Elongation of inch sections, 0″, 0″, ″.03*, 0″, 0″, 0″.
Contraction of area, inappreciable.
Position of fracture, 2″.62 from the neck.
Appearance of fracture, coarse granular, 60 per cent; dark brown, vesicular, 40 per cent.

No. 8179.

Marks, 31.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0009	.....	
10,000	.0020	0.	
15,000	.0031	.....	
20,000	.0043	.....	
25,000	.0056	.....	
30,000	.0071	.0004	
35,000	.0091	.0013	
38,000	.0109	.....	
40,000	.0126	.0036	
42,000	.0155	.....	
46,000	.03	.....	
47,100	.....	.....	Tensile strength.
0	.04	.....	= 0.7 per cent.

Elongation of inch sections, 0″, ″.03*, ″.01, 0″, 0″, 0″.
Contraction of area, inappreciable.
Position of fracture, 1″.3 from the neck.
Appearance of fracture, coarse granular. Opened two transverse cracks in surface of stem.

No. 8180.

Marks, 32.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0009	.....	
10,000	.0020	0.	
15,000	.0030	.....	
20,000	.0041	.....	
25,000	.0052	.....	
30,000	.0066	.0004	
35,000	.0082	.0010	
38,000	.0095	.....	
40,000	.0106	.0022	
42,000	.0121	.....	
45,000	.0152	.0054	
48,000	.0203	.0096	
50,000	.02+	.....	
54,000	.06	.....	
58,000	.10	.....	
60,000	.13	.....	
61,300	.....	.....	Tensile strength.
0	.16	.....	=2.7 per cent.

Elongation of inch sections, ″.02, ″.01, ″.03, ″.07*, ″.02, ″.01.
Diameter at fracture, 1″.10; area, .95 square inch.
Contraction of area, 5 per cent.
Position of fracture, 2″.84 from the neck.
Appearance of fracture, coarse granular. Opened three cracks in surface of stem.

No. 8181.

Marks, 33.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0008	.....	
10,000	.0019	0.	
15,000	.0030	.....	
20,000	.0041	.....	
25,000	.0052	.....	
30,000	.0067	.0005	
35,000	.0085	.0013	
38,000	.0098	.....	
40,000	.0111	.0026	
42,000	.0125	.....	
45,000	.0154	.0059	
48,000	.0203	.0102	
50,000	.03	.....	
52,000	.04	.....	
54,000	.06	.....	
56,000	.08	.....	
58,000	.10	.....	
60,000	.12	.....	
62,000	.15	.....	
64,000	.18	.....	Cracks in stem visible in three places.
66,000	.22	.....	
68,000	.27	.....	
70,000	.34	.....	
71,400	.....	.....	Tensile strength.
0	.39	.....	=6.5 per cent.

Elongation of inch sections, ″.05, ″.06, ″.07, ″.07, ″.09*, ″.05.
Diameter at fracture, 1″.08; area, .92 square inch.
Contraction of area, 8 per cent.
Position of fracture, 2″.08 from the neck.
Appearance of fracture, coarse granular.

No. 8182.

Marks, 34.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0009	.....	
10,000	.0020	0.	
15,000	.0030	.....	
20,000	.0040	.....	
25,000	.0052	.....	
30,000	.0064	.0004	
35,000	.0084	.0010	
38,000	.0094	.....	
40,000	.0106	.0022	
42,000	.0120	.....	
45,000	.0150	.0054	
48,000	.0194	.....	
50,000	.0250	.0146	
54,000	.05	.....	
56,000	.07	.....	
58,000	.09	.....	
60,000	.12	.....	
62,000	.14	.....	
64,000	.16	.....	
66,000	.20	.....	
68,000	.25	.....	
70,000	.31	.....	
72,000	.37	.....	
74,000	.48	.....	
76,000	.66	.....	
77,100	.....	.....	Tensile strength.
0	.81	.....	=13.5 per cent.

Elongation of inch sections, ″.10, ″.12, ″.13, ″.20*, ″.15, ″.11.
Diameter at fracture, 1″.02; area, .82 square inch.
Contraction of area, 18 per cent.
Position of fracture, 3″.08 from the neck.
Appearance of fracture, coarse granular.

LONGITUDINAL SPECIMENS FROM MIDDLE OF SLICE FROM UPPER HALF OF INGOT.

No. 8183.

Marks, 35.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0007	.....	
10,000	.0018	0.	
15,000	.0028	.....	
20,000	.0039	.....	
25,000	.0050	.....	
30,000	.0062	.0003	
35,000	.0086	.0015	
			Sustained 34,000 pounds per square inch for one hour.
38,000	.0096	.....	
40,000	.0105	.0024	
42,000	.0120	.....	
45,000	.0145	.0053	
48,000	.0180	.....	
50,000	.0224	.0120	
54,000	.04	.....	
58,000	.07	.....	
60,000	.10	.....	
62,000	.12	.....	
64,000	.16	.....	
66,000	.19	.....	
68,000	.24	.....	
69,800	.....	.....	Tensile strength.
0	.28	.....	=4.7 per cent.

Elongation of inch sections, ″.04, ″.04, ″.05, ″.04, ″.05*, ″.06.
Diameter at fracture, 1″.10; area, .95 square inch.
Contraction of area, 5 per cent.
Position of fracture, 1″.12 from the neck.
Appearance of fracture, coarse granular.

No. 8184.

Marks, 36.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0008	.....	
10,000	.0017	0.	
15,000	.0029	.....	
20,000	.0040	.....	
25,000	.0051	.....	
30,000	.0066	.0002	
35,000	.0083	.0010	
38,000	.0096	.....	
40,000	.0106	.0022	
42,000	.0118	.....	
45,000	.0130	.0044	
48,000	.0165	.....	
50,000	.0188	.0082	
52,000	.0225	.....	
55,000	.0300	.0180	
58,000	.05	.....	
60,000	.07	.....	
62,000	.08	.....	
64,000	.11	.....	Cracks visible in surface of stem in three places.
66,000	.16	.....	
68,000	.20	.....	
69,900	.....	.....	Tensile strength.
0	.23	.....	=3.8 per cent.

Elongation of inch sections, ″.03, ″.04, ″.03, ″.06*, ″.04, ″.03.
Diameter at fracture, 1″.10; area, .95 square inch.
Contraction of area, 5 per cent.
Position of fracture, 2″.41 from the neck.
Appearance of fracture, coarse granular.

No. 8185.

Marks, 37.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0009	.....	
10,000	.0021	0.	
15,000	.0032	.....	
20,000	.0044	.....	
25,000	.0058	.....	
30,000	.0077	.0011	
35,000	.0104	.0027	
38,000	.....	.....	Tensile strength.
0	.03	.....	=0.5 per cent.

Elongation of inch sections, 0″, 0″, 0″, 0″, ″.03*, 0″.
Contraction of area, inappreciable.
Position of fracture, 1″.25 from the neck.
Appearance of fracture, coarse granular.

No. 8186.

Marks, 38.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 6″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0009	.....	
10,000	.0020	0.	
15,000	.0031	.....	
20,000	.0045	.....	
25,000	.0061	.....	
30,000	.0085	.0017	
35,000	.0128	.0044	
36,200	.....	.....	Tensile strength.
0	.03	.....	=0.5 per cent.

Elongation of inch sections, 0″, 0″, 0″, ″.03*, 0″, 0″.
Contraction of area, inappreciable.
Position of fracture, 3″ from the neck.
Appearance of fracture, coarse granular, 80 per cent; dark brown, vesicular, 20 per cent.

FORGED SPECIMENS FROM SLICE FROM UPPER HALF OF INGOT.

No. 8187.

Marks, O_1.
Diameter, 1″.0092.
Sectional area, .80 square inch.
Gauged length, 10″.
Metal drawn down under the hammer in a direction parallel to the columnar structure of the ingot.
Drawn down from bar 1⅝″ by 3″ to 1″.3 square, and then annealed.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Elongation.	Set.	
Pounds.	*Pounds.*	*Inches.*	*Inch.*	
800	1,000	0.	0.	Initial load.
4,000	5,000	.0014	.....	
8,000	10,000	.0030	.....	
16,000	20,000	.0067	.....	
24,000	30,000	.0102	0.	
28,000	35,000	.0120	.....	
32,000	40,000	.0139	.....	
32,800	41,000	.0143	.....	
33,600	42,000	.0148	.....	
34,400	43,000	.0152	.....	
35,200	44,000	.0158	.....	
36,000	45,000	.0165	.....	Elastic limit.
36,800	46,000	.0175	.....	
		.0180	.....	
37,600	47,000	.0189	.....	
38,400	48,000	.0238	.....	Load fell.
36,800	46,000	.0360	.....	
37,600	47,000	.0370	.....	
38,400	48,000	.0387	.....	
39,200	49,000	.0551	.....	
40,000	50,000	.0690	.....	
41,600	52,000	.09	.....	
43,200	54,000	.12	.....	
44,800	56,000	.16	.....	
46,400	58,000	.20	.....	
48,000	60,000	.24	.....	
49,600	62,000	.28	.....	
51,200	64,000	.34	.....	
52,800	66,000	.39	.....	
54,400	68,000	.45	.....	
56,000	70,000	.54	.....	
57,600	72,000	.63	.....	
59,200	74,000	.77	.....	
60,800	76,000	.99	.....	
62,400	78,000	1.50	.....	
62,600	78,250	.....	.....	Tensile strength.
0	0	2.35	.....	=23.5 per cent.

Elongation of inch sections, ″.13, ″.17, ″.20, ″.23, ″.57*, ″.35, ″.20, ″.19, ″.17, ″.14.
Diameter at fracture, ″.65; area, .332 square inch.
Contraction of area, 58.5 per cent.
Position of fracture, 6″.15 from the neck.
Appearance of fracture, fine silky, cup-shaped.

No. 8188.

Marks, O_2.
Diameter, 1″.0092.
Sectional area, .80 square inch.
Gauged length, 10″.
From same bar as O_1.

Applied loads.		In gauged length.		Remarks
Total.	Per square inch.	Elongation.	Set.	
Pounds.	*Pounds.*	*Inches.*	*Inch.*	
800	1,000	0.	0.	Initial load.
4,000	5,000	.0011	.....	
8,000	10,000	.0030	.....	
16,000	20,000	.0061	.....	
24,000	30,000	.0097	0.	
28,000	35,000	.0114	.....	
32,000	40,000	.0133	.....	
32,800	41,000	.0137	.....	
33,600	42,000	.0141	.....	
34,400	43,000	.0147	.....	
35,200	44,000	.0151	.....	
36,000	45,000	.0157	.....	
36,800	46,000	.0163	.....	
37,600	47,000	.0171	.....	Elastic limit.
		.0178	.....	
38,400	48,000	.0191	.....	
39,200	49,000	.0445	.....	
40,000	50,000	.0700	.....	
41,600	52,000	.10	.....	
43,200	54,000	.13	.....	
44,800	56,000	.16	.....	
46,400	58,000	.19	.....	
48,000	60,000	.23	.....	
49,600	62,000	.27	.....	
51,200	64,000	.32	.....	
52,800	66,000	.38	.....	
54,400	68,000	.44	.....	
56,000	70,000	.53	.....	
57,600	72,000	.62	.....	
59,200	74,000	.73	.....	
60,800	76,000	.93	.....	
62,400	78,000	1.40	.....	
62,900	78,625	.....	.....	Tensile strength.
0	0	2.24	.....	=22.4 per cent.

Elongation of inch sections, ″.15, ″.19, ″.33, ″.56*, ″.23, ″.18, ″.17, ″.17, ″.14, ″.12.
Diameter at fracture, ″.66; area, .342 square inch.
Contraction of area, 57.2 per cent.
Position of fracture, 4″.25 from the neck.
Appearance of fracture, fine silky, cup-shaped.

No. 8189.

Marks, P_1.
Diameter, 1″.0092.
Sectional area, .80 square inch.
Gauged length, 10″.
Metal drawn down under the hammer; drawn perpendicular to the direction of the columnar structure. Bar 1⅝″ by 3″ drawn to 1″.3 square and annealed.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Elongation.	Set.	
Pounds.	*Pounds.*	*Inches.*	*Inch.*	
800	1,000	0.	0.	Initial load.
4,000	5,000	.0012	0.	
8,000	10,000	.0031	.....	
16,000	20,000	.0065	.....	
24,000	30,000	.0099	0.	
28,000	35,000	.0115	.....	
32,000	40,000	.0134	.....	
32,800	41,000	.0140	.....	
33,600	42,000	.0143	.....	
34,400	43,000	.0147	.....	
35,200	44,000	.0150	.....	
36,000	45,000	.0157	.....	
36,800	46,000	.0162	.....	
37,600	47,000	.0160	.....	Elastic limit.
		.0174	.....	
38,400	48,000	.0204	.....	
39,200	49,000	.0610	.....	
40,000	50,000	.0890	.....	
41,600	52,000	.13	.....	
43,200	54,000	.16	.....	
44,800	56,000	.19	.....	
46,400	58,000	.23	.....	
48,000	60,000	.28	.....	
49,600	62,000	.32	.....	
51,200	64,000	.38	.....	
52,800	66,000	.44	.....	
54,400	68,000	.52	.....	
56,000	70,000	.60	.....	
57,600	72,000	.71	.....	
59,200	74,000	.88	.....	
60,800	76,000	1.20	.....	
61,800	77,250	.....	.....	Tensile strength.
0	0	2.21	.....	=22.1 per cent.

Elongation of inch sections, ″.14, ″.19, ″.18, ″.26, ″.57*, ″.24, ″.18, ″.18, ″.15, ″.12.
Diameter at fracture, ″.72; area, .407 square inch.
Contraction of area, 49.1 per cent.
Position of fracture, 5″.45 from the neck.
Appearance of fracture, fine silky.

No. 8190.

Marks, P_2.
Diameter, 1″.0092.
Sectional area, .80 square inch.
Gauged length, 10″.
From same part of ingot as P_1, and drawn down and annealed in the same manner.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Elongation.	Set.	
Pounds.	*Pounds.*	*Inches.*	*Inch.*	
800	1,000	0.	0.	Initial load.
4,000	5,000	.0012	0.	
8,000	10,000	.0030	.....	
16,000	20,000	.0062	.....	
24,000	30,000	.0099	0.	
28,000	35,000	.0118	.....	
32,000	40,000	.0133	.....	
32,800	41,000	.0140	.....	
33,600	42,000	.0143	.....	
34,400	43,000	.0150	.....	
35,200	44,000	.0155	.....	
36,000	45,000	.0160	.....	
36,800	46,000	.0167	.....	Elastic limit.
37,600	47,000	.0178	.....	
		.0184	.....	
38,400	48,000	.0252	.....	
39,200	49,000	.0745	.....	
40,000	50,000	.0890	.....	
41,600	52,000	.12	.....	
43,200	54,000	.14	.....	
44,800	56,000	.18	.....	
46,400	58,000	.22	.....	
48,000	60,000	.26	.....	
49,600	62,000	.31	.....	
51,200	64,000	.36	.....	
52,800	66,000	.43	.....	
54,400	68,000	.50	.....	
56,000	70,000	.61	.....	
57,600	72,000	.74	.....	
59,200	74,000	.88	.....	
60,800	76,000	1.20	.....	
62,200	77,750	.....	.....	Tensile strength.
0	0	2.47	.....	=24.7 per cent.

Elongation of inch sections, ″.15, ″.17, ″.23, ″.25, ″.30, ″.62*, ″.23, ″.20, ″.18, ″.14.
Diameter at fracture, ″.67; area, .353 square inch.
Contraction of area, 55.9 per cent.
Position of fracture, 6″.02 from the neck.
Appearance of fracture, fine silky, cup-shaped.

TABULATION OF TENSILE SPECIMENS FROM HARMET STEEL INGOT.

SPECIMENS TAKEN FROM UPPER HALF AND MIDDLE OF LENGTH OF INGOT.

Diameter of specimens, 1″.129; length of stems, 6″ and 10″.

No. of test.	Marks.	Description and treatment.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
			Pounds.	*Pounds.*	*Per ct.*	*Per ct.*	″ ″ ″ ″ ″ ″	
8136	A			32,600	0.5	(a)	-0, 0, 0, .03*, 0, 0	Granular and columnar, 70 per cent; dark brown, 30 per cent.
8137	B			41,700	0.5	(a)	0, 0, 0, .03*, 0, 0	Columnar, dendritic.
	C			20,800	0.	0.		Dark brown, 55 per cent; granular, 45 per cent.
8138	D			33,900	0.5	(a)	0, 0, 0, .0, .03*, 0	Coarse granular, 60 per cent; columnar, dendritic, 40 per cent.
8139	E			64,200	2.7	5.0	.01, .03, .02, .02, .06*, .02	Coarse granular, and flaky. Opened cracks.
8140	F			70,000	5.9	8.0	.05, .05, .05, .07, .09*, .06, .05, .07, .04, .06	Coarse granular, flaky.
8141	G			70,000	6.0	7.0	.05, .05, .06, .06, .06, .05, .07, .05, .09*, .06	Do.
8142	H			67,500	4.2	5.0	.04, .03, .04, .06, .07*, .03, .04, .04, .05, .02	Do.
8143	I			73,700	11.2	15.0	.08, .09, .10, .12, .11, .12, .17*, .12, .11, .10	Do.
8144	J			47,800	0.5	(a)	0, 0, 0, .01, 0, .02*	Coarse granular; brilliant facets.
8145	K			62,900	2.7	3.0	.01, .03, .07*, .02, .01, .02	Do.
8146	L			64,200	2.0	(a)	.01, .02, .03, .02, .02, .02	Irregular; coarse granular.
8147	M			37,500	0.7	(a)	0, 0, .01, 0, .03*, 0	Coarse granular, 60 per cent; dark brown, vesicular patch, 40 per cent.
	Q		b 51,000	62,500	2.8	5.0	.03, .04*, .03, .03, .02, .02	Flaky; granular. Opened cracks along stem.
	R			31,600				Smooth, bright, lustrous, 45 per cent; granular, 55 per cent.
8148	S			54,300	1.0	(a)	0, .01, .03*, .01, 0, .01	Coarse granular, flaky.
8149	1			48,700	1.3	(a)	.05*, .01, .01, .01, 0, 0	Coarse granular, flaky. Dark brown spot.
8150	2	Annealed		55,800	3.5	3.0	.03, .02, .05, .07*, .02, .02	Gray, columnar, vesicular. Dark brown spot.
8151	3			25,900	(a)	(a)		Coarse granular, 50 per cent; dark brown, columnar, and vesicular, 50 per cent.
8152	4	Annealed	54,200	76,700	25.0	39.0	.15, .25, .49*, .26, .20, .15	Columnar, vesicular; gray.
8153	5			64,100	2.3	3.0	.01, .05*, .03, .01, .02, .02	Coarse granular.
8154	6	Annealed		45,800	1.7	5.0	0, 0, 0, 0, .10*, 0	Gray, amorphous, 60 per cent; vesicular, 40 per cent.
8155	7			53,900	0.3	(a)	.01*, 0, 0, .01, 0, 0	Coarse granular, flaky, 70 per cent; oblique, vesicular, 30 per cent.
8156	8	Annealed	51,000	63,900	6.2	13.0	.03, .05, .04, .03, .04, .18*	Gray, amorphous.
8157	9			69,100	3.5		.05, .03, .04, .03, .03, .03	Coarse granular, flaky.
8158	10	Annealed	54,800	77,200	20.8	25.0	.17, .25, .31*, .21, .17, .14	Silky, oblique.

8159	11			70,600	5.3	8.0	.04,	.06,	.09*,	.04,	.05,	.04	Coarse granular, 85 per cent; smooth, lustrous, oblique, 15 per cent.
8160	12			73,400	11.0	13.0	.09,	.09,	.18*,	.13,	.10,	.07	Coarse granular.
8161	13	Annealed	53,000	68,200	8.3	15.0	.18*,	.09,	.05,	.06,	.06,	.06	Dull silky; oblique.
8162	14			56,300	1.3	(a)	.01,	.01,	.01,	.01,	.02*,	.02	Coarse granular; in part smooth, lustrous, oblique.
8163	15	Annealed	49,000	58,200	4.7	12.0	.03,	.03,	.02,	.03,	.04,	.13	Silky, 90 per cent; smooth, lustrous, oblique, 10 per cent.
8164	16			72,600	8.3	10.0	.07,	.07,	.08,	.14*,	.08,	.06	Coarse granular.
8165	17	Annealed	53,900	72,500	11.8	17.0	.09,	.09,	.22*,	.15,	.08,	.08	Silky.
8166	18			73,200	18.7	36.0	.11,	.16,	.25,	.37*,	.13,	.10	Silky, interspersed with granular metal.
8167	19	Annealed	53,800	76,000	16.2	25.0	.13,	.32*,	.14,	.13,	.12,	.13	Silky.
8168	20			70,000	6.5	8.0	.06,	.05,	.06,	.06,	.09*,	.07*	Coarse granular.
8169	21			52,000	0.7	(a)	.01,	0,	0,	.02*,	.01,	0	Smooth, lustrous, 85 per cent; dull brown surface, 15 per cent.
8170	22	Annealed		63,400	5.8	17.0	.03,	.05,	.17*,	.03,	.03,	.04	Dull gray, silky; in part smooth, oblique.
8171	23			63,900	2.8	3.0	.02,	.06*,	.02,	.02,	.03,	.02	Granular, flaky, lustrous.
8172	24	Annealed		49,700	2.7	15.0	0,	0,	.15*,	.01,	0,	0	Silky, oblique, 85 per cent; smooth, lustrous, 15 per cent.
8173	25			44,200	0.7	(a)	.0,	.04*,	0,	0,	0,	0	Coarse granular; flaky, lustrous.
8174	26	Annealed		47,900	1.7	10.0	0,	.02,	.08*,	0,	0,	0	Dull gray, silky, 70 per cent; smooth, lustrous, 30 per cent.
8175	27			74,800	10.2	12.0	09,	.10,	.09,	.10,	.13*,	.10	Coarse granular, striated.
8176	28			49,600	0.7	(a)	0,	.03*,	0,	0,	.01,	0	Coarse granular, flaky; in part columnar.
8177	29			50,600	0.5	(a)	.02*,	0,	.01,	0,	0,	0	Granular, flaky; lustrous, striated.
8178	30			34,700	0.5	(a)	0,	0,	.03*,	0,	0,	0	Coarse granular, 60 per cent; dark brown, vesicular, 40 per cent.
8179	31			47,100	0.7	(a)	0,	.03*,	.01,	0,	0,	0	Coarse granular.
8180	32			61,300	2.7	5.0	.02,	.01,	.03,	.07*,	.02,	.01	Do.
8181	33			71,400	6.5	8.0	.05,	.06,	.07,	.07,	.09*,	.05	Do.
8182	34			77,100	13.5	18.0	.10,	.12,	.13,	.20*,	.15,	.11	Do.
8183	35			69,800	4.7	5.0	.04,	.04,	.05,	.04,	.05*,	.06	Do.
8184	36			69,900	3.8	5.0	.03,	.04,	.03,	.06*,	.04,	.03	Do.
8185	37			38,000	0.5	(a)	0,	0,	0,	0,	.03*,	0	Do.
8186	38			36,200	0.5	(a)	0,	0,	0,	.03*,	0,	0	Coarse granular, 80 per cent; dark brown vesicular, 20 per cent.
8187	O_1	Drawn down under the hammer from 1⅛" by 3" to 1".3 square, and then annealed.	45,000	78,250	23.5	58.5	.13, .35,	.17, .20,	.20, .19,	.23, .17,	.57*, .14		Fine silky; cup shaped.
8188	O_2	....do	47,000	78,625	22.4	57.2	.15, .18,	.19, .17,	.33, .17,	.56*, .14,	.23, .12		Do.
8189	P_1	....do	47,000	77,250	22.1	49.1	.14, .24,	.19, .18,	.18, .18,	.26, .15,	.57*, .12		Fine silky.
8190	P_2	....do	46,000	77,750	24.7	55.9	.15, .62*,	.17, .23,	.23, .20,	.25, .18,	.30, .14		Fine silky; cup shaped.
	L	Longitudinal specimen at middle of upper half of ingot.		25,100									
	T	Transverse specimen at middle of height of ingot.		67,300									

[a] Inappreciable.

[b] Approximate.

TENSILE TESTS OF SPECIMENS FROM HARMET STEEL INGOT.

SPECIMENS TAKEN FROM LOWER HALF.

No. 8295.

Longitudinal specimen, from edge of slice.
Marks, 1.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0013	0.	
10,000	.0032	.....	
20,000	.0070	.....	
30,000	.0107	0.	
35,000	.0124	.0001	
37,000	.0131	.....	
38,000	.0139	.....	
39,000	.0143	.....	
40,000	.0149	.0010	
41,000	.0154	.....	
42,000	.0161	.....	
43,000	.0171	.....	
44,000	.0181	.....	
45,000	.0204	.0044	
46,000	.0225	.....	
47,000	.0247	.....	
48,000	.0296	.....	
50,000	.0500	.....	
52,000	.09	.....	
54,000	.13	.....	
56,000	.17	.....	
58,000	.21	.....	
60,000	.25	.....	
64,000	.37	.....	
68,000	.53	.....	
72,000	.80	.....	
75,100	.....	.....	Tensile strength.
0	1.32	.....	=13.2 per cent elongation.

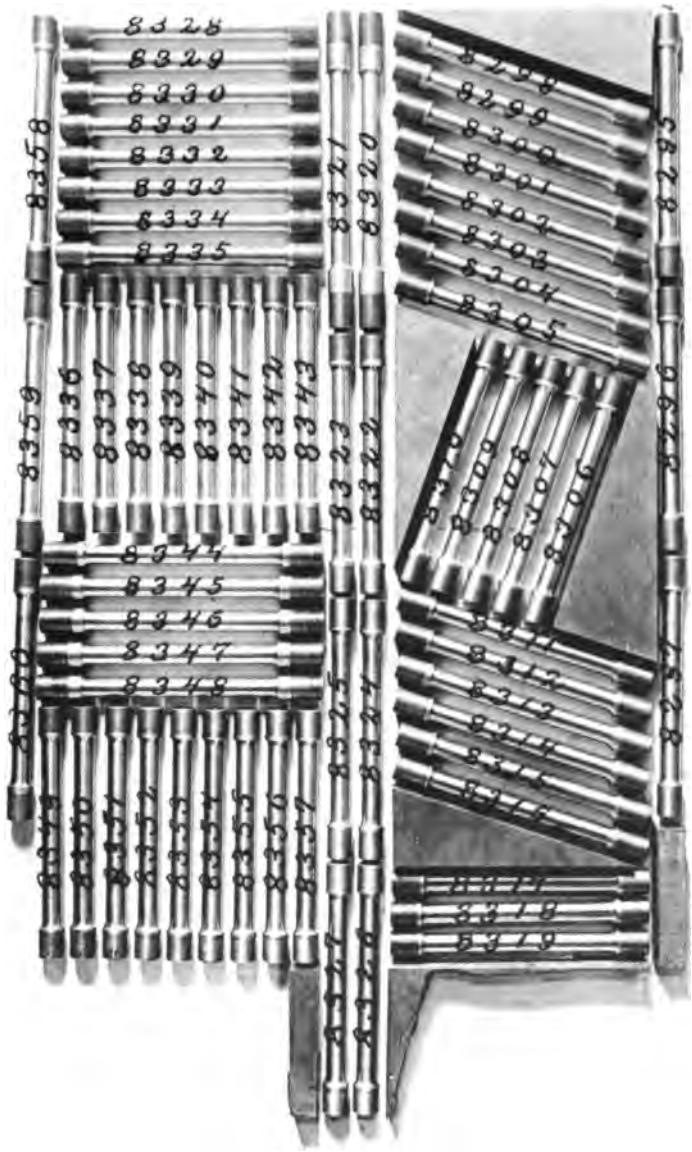
Elongation of inch sections, ″.09, ″.13, ″.11, ″.15, ″.25*, ″.14, ″.12, ″.12, ″.12, ″.09.

Diameter at fracture, 1″.02; area, .817 square inch.

Contraction of area, 18.3 per cent.

Fractured 4″.45 from the neck.

Appearance of fracture, dull gray, amorphous; opened small, circular cavities in surface of stem.

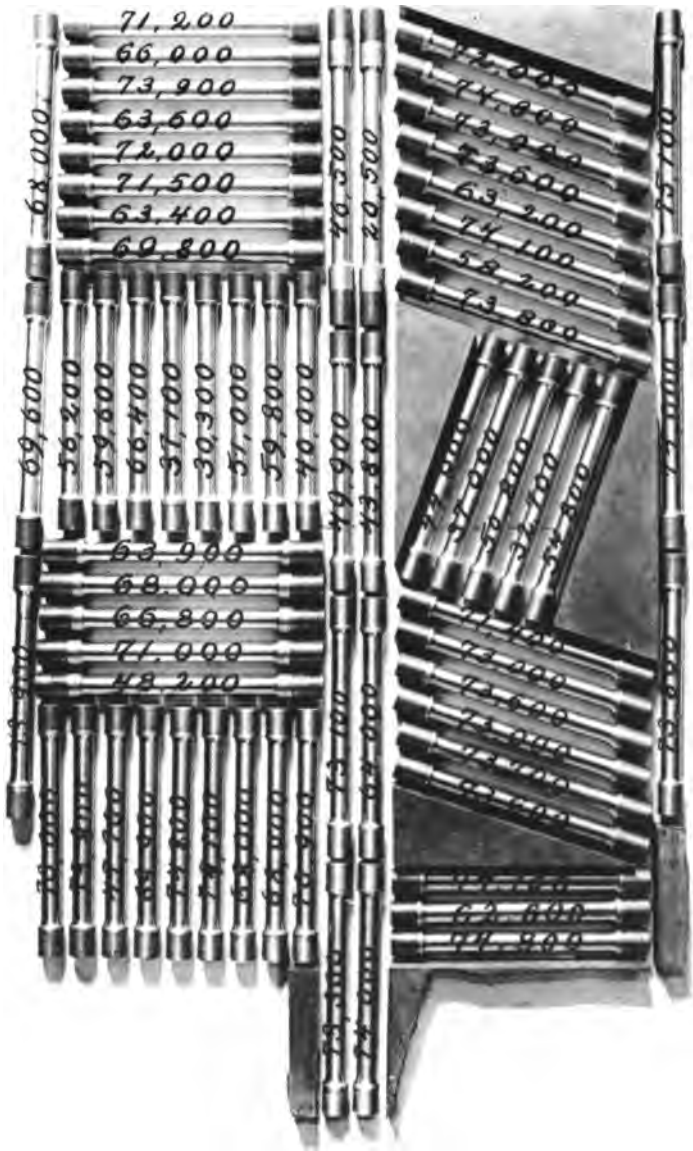


NO. 6.

HARMET STEEL INGOT.

POSITION AND TEST NUMBERS OF SPECIMENS IN SLICE FROM LOWER HALF OF INGOT.

CAMPBELL ART CO.



NO. 7.

HARVEY STEEL INGOT.

TENSILE STRENGTH OF SPECIMENS FROM SLICE FROM LOWER HALF OF INGOT.

No. 8296.

Longitudinal specimen, from edge of slice, annealed.
Marks, 2.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0015	0.	
30,000	.0103	0.	
35,000	.0121	.....	
40,000	.0140	.0001	
45,000	.0159	.0003	
46,000	.0162	.....	
47,000	.0168	.....	
48,000	.0173	.....	
49,000	.0180	.....	
50,000	.0187	.0010	
51,000	.0199	.....	Elastic limit. Load fell.
46,000	.0555	.....	
47,000	.0591	.....	
48,000	.0680	.....	
50,000	.1700	.....	
52,000	.23	.....	
54,000	.28	.....	
56,000	.33	.....	
60,000	.44	.....	
64,000	.60	.....	
68,000	.82	.....	
72,000	1.26	.....	
74,000	.....	.....	Tensile strength.
0	2.52	.....	=25.2 per cent elongation.

Elongation of inch sections, ″.15, ″.19, ″.23, ″.25, ″.26, ″.55*, ″.35, ″.22, ″.19, ″.13.

Diameter at fracture, ″.79; area, .490 square inch.

Contraction of area, 51 per cent.

Fractured 4″.24 from the neck.

Appearance of fracture, silky; opened minute cracks in surface of stem.

No. 8297.

Longitudinal specimen, from edge of slice.
Marks, 3.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0014	0.	
30,000	.0104	0.	
35,000	.0124	.....	
36,000	.0130	.....	
37,000	.0137	.....	
38,000	.0141	.....	
39,000	.0150	.....	
40,000	.0161	.0024	
41,000	.0174	.....	
42,000	.0198	.....	
43,000	.0219	.....	
44,000	.0255	.....	
45,000	.0411	.0248	
46,000	.0518	.....	
48,000	.08	.....	
50,000	.12	.....	
52,000	.16	.....	
56,000	.23	.....	
60,000	.33	.....	
64,000	.48	.....	
68,000	.68	.....	
72,000	1.13	.....	
73,800	.....	.....	Tensile strength.
0	1.93	.....	=19.3 per cent elongation.

Elastic limit not well defined.

Elongation of inch sections: ″.13, ″.15, ″.17, ″.19, ″.20, ″.37*, ″.25, ″.19, ″.15, ″.13.

Diameter at fracture, ″.93; area, .679 square inch.

Contraction of area, 32.1 per cent.

Fractured 4″.20 from the neck.

Appearance of fracture, dull gray, with numerous lighter colored spots; amorphous.

No. 8298.

Transverse specimen.
Marks, 4.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0013	0.	
30,000	.0111	.0004	
34,000	.0130	.....	
35,000	.0139	.0019	
36,000	.0148	.....	
37,000	.0151	.....	
38,000	.0160	.....	
39,000	.0169	.....	
40,000	.0182	.0040	
41,000	.0200	.....	
42,000	.0209	.....	
43,000	.0222	.....	
44,000	.0241	.....	
45,000	.0273	.0119	
46,000	.0302	.....	
47,000	.0349	.....	
48,000	.0400	.....	
50,000	.0570	.....	
52,000	.08	.....	
56,000	.17	.....	
60,000	.28	.....	
64,000	.41	.....	Crack opened in stem.
68,000	.59	.....	
72,000	.....	.....	Tensile strength.
0	1.17	.....	=11.7 per cent elongation.

Elongation of inch sections: ″.09, ″.11, ″.08, ″.25*, ″.09, ″.10, ″.11, ″.13, ″.12, ″.09.

Diameter at fracture, 1″.01; area, .801 square inch.

Contraction of area, 19.9 per cent.

Fractured 3″.4 from the neck.

Appearance of fracture, dull gray, in part granular; opened oblique cracks in three places in stem.

No. 8299.

Transverse specimen, annealed.
Marks, 5.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0012	0.	
10,000	.0030	.....	
30,000	.0100	0.	
40,000	.0138	.0002	
41,000	.0147	.....	
42,000	.0151	.....	
43,000	.0157	.....	
44,000	.0161	.....	
45,000	.0168	.0010	
46,000	.0174	.....	
47,000	.0180	.....	
48,000	.0189	.....	Elastic limit. Load fell.
47,000	.0315	.....	
48,000	.0590	.....	
49,000	.0800	.....	
50,000	.13	.....	
52,000	.21	.....	
54,000	.26	.....	
56,000	.31	.....	
60,000	.41	.....	
64,000	.56	.....	
68,000	.76	.....	
72,000	1.11	.....	
74,800	.....	.....	Tensile strength.
0	2.09	.....	=20.9 per cent elongation.

Elongation of inch sections, ″.16, ″.28, ″.47*, ″.23, ″.18, ″.17, ″.17, ″.14, ″.15, ″.14.
Diameter at fracture, ″.87; area, .594 square inch.
Contraction of area, 40.6 per cent.
Fractured 3″ from the neck.
Appearance of fracture, silky; opened cracks in stem.

No. 8300.

Transverse specimen.
Marks, 6.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0012	0.	
10,000	.0033	.....	
30,000	.0110	.0003	
35,000	.0134	.....	
38,000	.0152	.....	
39,000	.0160	.....	
40,000	.0177	.0035	
41,000	.0190	.....	
42,000	.0202	.....	
43,000	.0216	.....	
44,000	.0232	.....	
45,000	.0262	.0100	
46,000	.0291	.....	
47,000	.0320	.....	
48,000	.0350	.....	
50,000	.0536	.....	
52,000	.08	.....	
56,000	.16	.....	
60,000	.26	.....	
64,000	.37	.....	
68,000	.58	.....	
72,000	1.03	.....	
73,000	.....	.....	Tensile strength.
0	1.62	.....	= 16.2 per cent elongation.

Elongation of inch sections, ″.10, ″.13, ″.17, ″.20, ″.18, ″.11, ″.12, ″.14, ″.26*, ″.21*.
Diameter at fracture, ″.98; area, .754 square inch.
Contraction of area, 24.6 per cent.
Fractured 1″.2 from the neck.
Appearance of fracture, dull gray, in part granular.

No. 8301.

Transverse specimen.
Marks, 7.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0013	0.	
10,000	.0031	.....	
30,000	.0107	.0002	
35,000	.0132	.....	
36,000	.0139	.....	
37,000	.0146	.....	
38,000	.0153	.....	
39,000	.0162	.....	
40,000	.0173	.0033	
41,000	.0186	.....	
42,000	.0198	.....	
43,000	.0211	.....	
44,000	.0230	.....	
45,000	.0250	.....	
46,000	.0280	.....	
48,000	.0363	.....	
50,000	.0500	.....	
52,000	.08	.....	
56,000	.12	.....	
60,000	.26	.....	
64,000	.39	.....	
68,000	.56	.....	
72,000	.93	.....	
73,600	.....	.....	Tensile strength.
0	1.69	.....	=16.9 per cent elongation.

Elongation of inch sections, ″.10, ″.11, ″.13, ″.12, ″.14, ″.31*, ″.30*, ″.17, ″.17, ″.14.
Diameter at fracture, ″.97; area, .739 square inch.
Contraction of area, 26.1 per cent.
Fractured 5″.36 from the neck.
Appearance of fracture, silky and granular metal interspersed.

No. 8302.

Transverse specimen.
Marks, 8.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0012	0.	
10,000	.0031	.....	
30,000	.0108	.0003	
35,000	.0132	.....	
36,000	.0140	.....	
37,000	.0147	.....	
38,000	.0155	.....	
39,000	.0163	.....	
40,000	.0180	.0038	
41,000	.0191	.....	
42,000	.0199	.....	
43,000	.0215	.....	
44,000	.0235	.....	
45,000	.0260	.....	
46,000	.0285	.....	
48,000	.0370	.....	
50,000	.0550	.....	
52,000	.08	.....	
56,000	.17	.....	
60,000	.28	.....	Cracks opened in stem.
63,200	.....	.....	Tensile strength.
0	.33	.....	= 3.3 per cent elongation.

Elongation of inch sections, ″.02, ″.03, ″.07*, ″.04, ″.03, ″.02, ″.04, ″.02, ″.03, ″.03.
Diameter at fracture, 1″.10; area, .950 square inch.
Contraction of area, 5 per cent.
Fractured 2″.15 from the neck.
Appearance of fracture, coarse granular.

No. 8303.

Transverse specimen, annealed.
Marks, 9.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0017	.0001	
10,000	.0038	.0002	
30,000	.0110	.0002	
35,000	.0126	.....	
40,000	.0145	.0002	
45,000	.0162	.0003	
46,000	.0168	.....	
47,000	.0171	.....	
48,000	.0176	.....	
49,000	.0180	.....	
50,000	.0187	.0010	
51,000	.0191	.....	
52,000	.0197	.....	Elastic limit.
53,000	.0210	.....	Load fell.
47,000	.0276	.....	
48,000	.0300	.....	
49,000	.0300	.....	
50,000	.1080	.....	
52,000	.21	.....	
56,000	.29	.....	
60,000	.40	.....	
64,000	.55	.....	
68,000	.74	.....	
72,000	1.14	.....	
74,100	.....	.....	Tensile strength.
0	1.47	.....	= 14.7 per cent elongation.

Elongation of inch sections, ″.11, ″.13, ″.14, ″.14, ″.15, ″.14, ″.15, ″.15, ″.23*, ″.13.

Diameter at fracture, 1″; area, .785 square inch.

Contraction of area, 21.5 per cent.

Fractured 1″.75 from the neck.

Appearance of fracture, silky, irregular; opened cracks in surface of stem.

No. 8304.

Transverse specimen.
Marks, 10.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch*	
1,000	0.	0.	Initial load.
5,000	.0012	0.	
10,000	.0032	.....	
30,000	.0108	.0003	
35,000	.0132	.....	
40,000	.0170	.0033	
41,000	.0190	.....	
42,000	.0202	.....	
43,000	.0213	.....	
44,000	.0232	.....	
45,000	.0269	.....	
46,000	.0301	.....	
47,000	.0340	.....	
48,000	.0380	.....	
50,000	.0600	.....	Crack in stem opened.
52,000	.08	.....	
56,000	.17	.....	
58,200	.....	.....	Tensile strength.
0	.21	.....	= 2.1 per cent elongation.

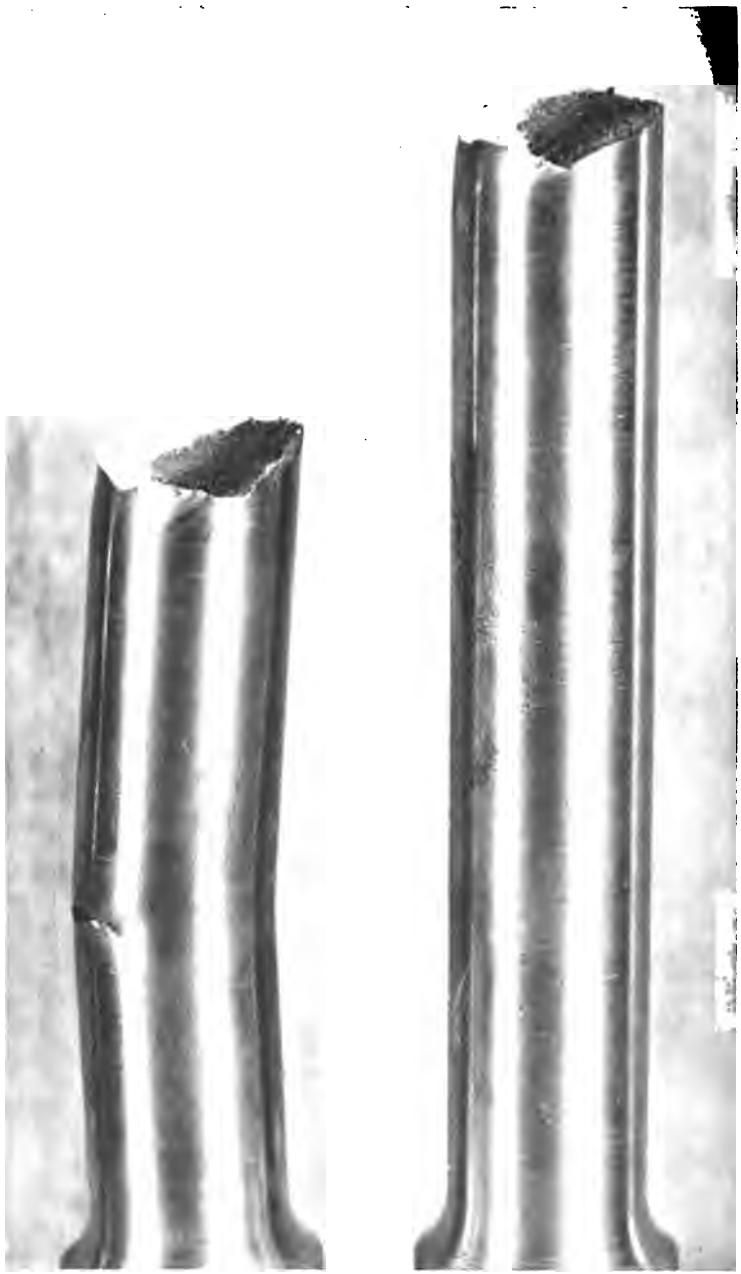
Elongation of inch sections: ″.02, ″.06*, ″.02, ″.02, ″.02, ″.02, ″.02, ″.01, ″.01, ″.01.
Diameter at fracture, 1″.1; area, .950 square inch.
Contraction of area, 5 per cent.
Fractured 1″.7 from the neck.
Appearance of fracture, coarse granular, flaky.

No. 8305.

Transverse specimen.
Marks, 11.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0012	0.	
10,000	.0031	.....	
30,000	.0106	.0003	
35,000	.0130	.....	
40,000	.0167	.0027	
41,000	.0178	.....	
42,000	.0188	.....	
43,000	.0200	.....	
44,000	.0220	.....	
45,000	.0242	.....	
46,000	.0265	.....	
48,000	.0330	.....	
50,000	.0450	.....	
52,000	.0700	.....	
56,000	.15	.....	
60,000	.26	.....	
64,000	.37	.....	
68,000	.55	.....	
72,000	.90	.....	
73,800	.....	.....	Tensile strength.
0	1.46	.....	=14.6 per cent elongation.

Elongation of inch sections, ″.09, ″.09, ″.10, ″.14, ″.13, ″.11, ″.10, ″.14, ″.35*, ″.21.
Diameter at fracture, ″.90; area, .636 square inch.
Contraction of area, 36.4 per cent.
Fractured 1″.4 from the neck.
Appearance of fracture, silky, trace of granulation.



NO. 8307.

HARMET STEEL INGOT.

APPEARANCE OF STEM OF SPECIMEN AFTER FRACTURE, SHOWING DISCOLORED PART OF FRACTURED SURFACE, AND CRACK IN STEM WHICH OPENED DURING THE TEST.

CAMPBELL ART CO.
ELIZABETH, N. J.

No. 8306.

Longitudinal specimen.
Marks, 12.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0013	0.	
10,000	.0032	.....	
30,000	.0105	0.	
35,000	.0128	.....	
40,000	.0160	.0020	
41,000	.0168	.....	
42,000	.0177	.....	
43,000	.0187	.....	
44,000	.0200	.....	
45,000	.0214	.0055	
46,000	.0231	.....	
47,000	.0250	.....	
48,000	.0270	.....	
49,000	.0300	.....	
50,000	.0350	.....	
52,000	.05	.....	
54,800	.....	.....	Tensile strength.
0	.09	.....	=0.9 per cent elongation.

Elongation of inch sections, ″.01, 0″, ″.01, ″.04*, 0″, 0″, ″.01, ″.01, 0″, ″.01.
Contraction of area, inappreciable.
Fractured 3″.9 from the neck.
Appearance of fracture, coarse granular.

No. 8307.

Longitudinal specimen, annealed.
Marks, 13.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0012	0.	
10,000	.0034	.....	
30,000	.0315	.0189	Cracks opened in stem.
32,700	.....	.....	Tensile strength.

Elongation inappreciable.
Contraction of area inappreciable.
Fractured 4″.5 from the neck.
Appearance of fracture, silky, 40 per cent; blue-black, 60 per cent; amorphous; a crack opened 2½″ from the place of rupture, which presented blue-black surfaces.

No. 8308.

Longitudinal specimen.
Marks, 14.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0013	0.	
10,000	.0031	.....	
30,000	.0105	0.	
35,000	.0131	.....	
40,000	.0178	.0030	
41,000	.0192	.....	
42,000	.0208	.....	
43,000	.0230	.....	
44,000	.0255	.....	
45,000	.0300	.0132	
46,000	.04	.....	Cracks opened in stem.
48,000	.06	.....	
50,000	.10	.....	
50,800	.....	.....	Tensile strength.
0	.12	.....	=1.2 per cent elongation.

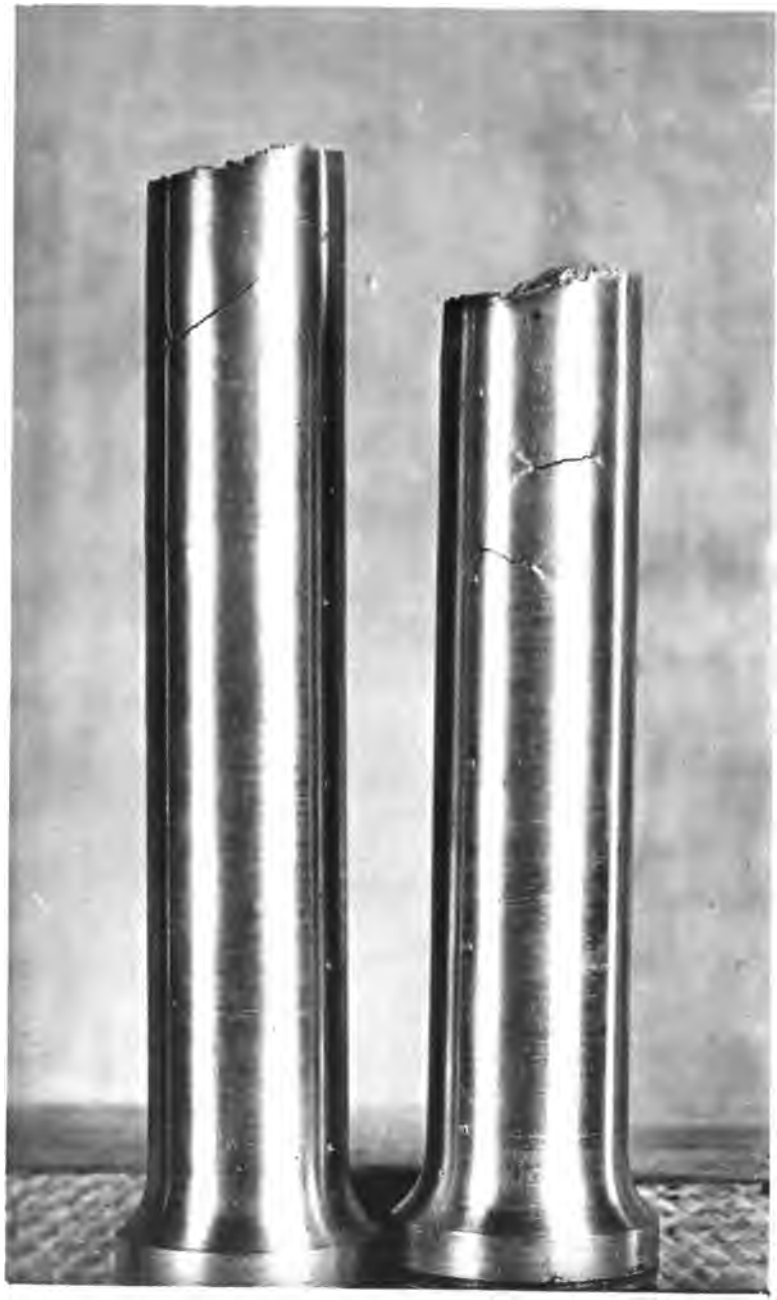
Elongation of inch sections, ″.01, ″.01, ″.01, ″.01, ″.04*, ″.02, ″.01, 0″, 0″, ″.01.
Diameter at fracture, 1″.10; area, .950 square inch.
Contraction of area, 5 per cent.
Fractured 4″.6 from the neck.
Appearance of fracture, coarse granular, 60 per cent; smooth, lustrous, 40 per cent. Cracks opened in stem in six places.

No. 8309.

Longitudinal specimen, annealed.
Marks, 15.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0016	.0001	
10,000	.0038	.....	
23,000	.....	.....	Cracks opened in stem.
37,000	.....	.....	Tensile strength.

Elongation inappreciable.
Contraction of area, inappreciable.
Fractured 3″ from the neck.
Appearance of fracture, silky, 50 per cent; blue-black, amorphous 50 per cent. Opened cracks in surface of stem.



NO. 8[illegible].

HARMET STEEL INGOT.

APPEARANCE OF STEM OF SPECIMEN AFTER FRACTURE, SHOWING CRACKS WHICH OPENED DURING THE TEST.

No. 8310.

Longitudinal specimen.
Marks, 16.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0013	0.	
10,000	.0032	.....	
30,000	.0114	.0010	
35,000	.0165	.0040	Crack opened in stem.
44,900	.....	.....	Tensile strength.

Fractured at the neck.
Appearance of fracture, coarse granular, 80 per cent; blue-black, amorphous, 20 per cent. Opened cracks in four places.

No. 8311.

Transverse specimen.
Marks, 17.
Diameter,1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0012	0.	
10,000	.0031	.....	
30,000	.0108	.0003	
35,000	.0130	.....	
40,000	.0167	.0030	
41,000	.0179	.....	
42,000	.0190	.....	
43,000	.0201	.....	
44,000	.0216	.....	
45,000	.0238	.....	
46,000	.0270	.....	
48,000	.0345	.....	
50,000	.0460	.....	
52,000	.0650	.....	
56,000	.14	.....	
60,000	.25	.....	
64,000	.36	.....	
68,000	.51	.....	
71,400	.....	.....	Tensile strength.
0	.81	.....	=8.1 per cent elongation.

Diameter at fracture, 1″.06; area, .882 square inch.
Contraction of area, 11.8 per cent.
Fractured 3″.25 from the neck.
Appearance of fracture, coarse granular.

No. 8312.

Transverse specimen.
Marks, 18.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0013	0.	
10,000	.0033	.....	
30,000	.0109	.0005	
35,000	.0130	.....	
40,000	.0170	.0030	
41,000	.0181	.....	
42,000	.0192	.....	
43,000	.0207	.....	
44,000	.0221	.....	
45,000	.0240	.....	
46,000	.0268	.....	
47,000	.0300	.....	
48,000	.0332	.....	
50,000	.0460	.....	
52,000	.07	.....	
56,000	.16	.....	
60,000	.24	.....	
64,000	.36	.....	
68,000	.52	.....	
72,000	.88	.....	
73,000	.....	.....	Tensile strength.
0	1.09	.....	=10.9 per cent elongation.

Elongation of inch sections, ″.14*, ″.09, ″.08, ″.09, ″.10, ″.09, ″.11, ″.17, ″.12, ″.10.
Diameter at fracture, 1″.07; area, .899 square inch.
Contraction of area, 10.1 per cent.
Fractured ″.15 from the neck.
Appearance of fracture, coarse granular; opened oblique seams.

No. 8313.

Transverse specimen, annealed.
Marks, 19.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0013	0.	
10,000	.0031	.....	
30,000	.0102	0.	
35,000	.0120	.....	
40,000	.0141	.0008	
41,000	.0147	.....	
42,000	.0152	.....	
43,000	.0157	.....	
44,000	.0162	.....	
45,000	.0169	.....	
46,000	.0176	.....	
47,000	.0185	.....	
48,000	.0197	.....	Elastic limit.
49,000	.0270	.....	Load fell.
44,000	.0282	.....	
45,000	.0298	.....	
46,000	.0330	.....	
48,000	.0600	.....	
50,000	.19	.....	
52,000	.24	.....	
56,000	.32	.....	
60,000	.43	.....	
64,000	.59	.....	
68,000	.78	.....	
72,000	1.16	.....	
73,600	.....	.....	Tensile strength.
0	1.80	.....	=18 per cent elongation.

Elongation of inch sections, ″.12, ″.13, ″.16, ″.17 ″.22, ″.34*, ″.21, ″.18, ″.15, ″.12.
Diameter at fracture, ″.94; area, .694 square inch.
Contraction of area, 30.6 per cent.
Fractured at middle of stem.
Appearance of fracture, silky. Opened two oblique cracks in stem.

No. 8314.

Transverse specimen.
Marks, 20.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0013	0.	
10,000	.0032	.....	
30,000	.0108	.0003	
35,000	.0132	.....	
40,000	.0172	.0031	
41,000	.0180	.....	
42,000	.0193	.....	
43,000	.0208	.....	
44,000	.0223	.....	
45,000	.0250	.....	
46,000	.0275	.....	
47,000	.0301	.....	
48,000	.0350	.....	
49,000	.0390	.....	
50,000	.0470	.....	
52,000	.07	.....	
56,000	.15	.....	
60,000	.24	.....	
64,000	.35	.....	
68,000	.52	.....	
72,000	.85	.....	
73,000	.....	.....	Tensile strength.
0	1.10	.....	=11 per cent elongation.

Elongation of inch sections, ″.09, ″.09, ″.08, ″.17*, ″.14, ″.11, ″.10, ″.11, ″.12, ″.09.
Diameter at fracture, 1″.05; area, .866 square inch.
Contraction of area, 13.4 per cent.
Fractured, 4″.1 from the neck.
Appearance of fracture, dull gray, amorpnous, in part granular.

No. 8315.

Transverse specimen.
Marks, 21.
Diameter, 1 ".129.
Sectional area, 1 square inch.
Gauged length, 10".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0013	0.	
10,000	.0032	.....	
30,000	.0109	.0002	
35,000	.0132	.....	
40,000	.0170	.0030	
41,000	.0182	.....	
42,000	.0198	.....	
43,000	.0212	.....	
44,000	.0230	.....	
45,000	.0256	.....	
46,000	.0280	.....	
47,000	.0320	.....	
48,000	.0355	.....	
49,000	.0430	.....	
50,000	.0510	.....	
52,000	.07	.....	
56,000	.14	.....	
60,000	.24	.....	
64,000	.36	.....	
68,000	.52	.....	
72,000	.91	.....	
73,700	.....	.....	Tensile strength.
0	1.53	.....	=15.3 per cent elongation.

Elongation of inch sections, ".11, ".17, ".41*, ".20, ".10, ".10, ".11, ".12, ".12, ".09.

Diameter at fracture, ".89; area, .622 square inch.

Contraction of area, 37.8 per cent.

Fractured 3 ".25 from the neck.

Appearance of fracture, silky, trace of granulation. Opened cracks in stem.

No. 8316.

Tranverse specimen.
Marks, 22.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0012	0.	
10,000	.0030	.....	
30,000	.0105	.0003	
35,000	.0132	.....	
36,000	.0140	.....	
37,000	.0148	.....	
38,000	.0158	.....	
39,000	.0164	.....	
40,000	.0177	.0039	
41,000	.0191	.....	
42,000	.0205	.....	
43,000	.0220	.....	
44,000	.0240	.....	
45,000	.0265	.....	
46,000	.0295	.....	
48,000	.0390	.....	
50,000	.0600	.....	
52,000	.09	.....	
56,000	.16	.....	
60,000	.27	.....	
64,000	.39	.....	
68,000	.58	.....	
72,000	.94	.....	
73,600	.....	.....	Tensile strength.
0	1.48	.....	=14.8 per cent elongation.

Elongation of inch sections, ″.13, ″.17, ″.15, ″.16, ″.13, ″.12, ″.21*, ″.18,″.14,″.09.

Diameter at fracture, 1″.04; area, .849 square inch.
Contraction of area, 15.1 per cent.
Fractured 4″.1 from the neck.
Appearance of fracture, coarse granular. Opened cracks in stem.

No. 8317.

Transverse specimen.
Marks, 23.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0014	0.	
10,000	.0032	.....	
30,000	.0111	.0002	
35,000	.0138	.....	
36,000	.0148	.....	
37,000	.0156	.....	
38,000	.0163	.....	
39,000	.0175	.....	
40,000	.0190	.0047	
41,000	.0208	.....	
42,000	.0222	.....	
43,000	.0243	.....	
44,000	.0270	.....	
45,000	.0310	.....	Cracks opened in stem.
47,100	.....	.....	Tensile strength.
0	.06	.....	=0.6 per cent elongation.

Elongation of inch sections, 0″, ″.04*, ″.01, ″.01, 0″, 0″, 0″, 0″, 0″, 0″.
Contraction of area, inappreciable.
Fractured 2″ from the neck.
Appearance of fracture, coarse granular, 70 per cent; blue-black, amorphous, 30 per cent.

No. 8318.

Transverse specimen, annealed.
Marks, 24.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0017	.0002	
10,000	.0035	.....	
30,000	.0108	.0003	
35,000	.0127	.....	
40,000	.0149	.0009	
41,000	.0152	.....	
42,000	.0158	.....	
43,000	.0162	.....	
44,000	.0168	.....	
45,000	.0175	.....	
46,000	.0182	.....	Elastic limit.
47,000	.0192	.....	
	.0202	.....	
48,000	.0580	.....	
49,000	.0830	.....	
50,000	.14	.....	Opened cracks in stem.
52,000	.23	.....	
56,000	.32	.....	
60,000	.43	.....	
62,600	.....	.....	Tensile strength.
0	.50	.....	=5 per cent elongation.

Elongation of inch sections, ″.09*, ″.05, ″.04, ″.06, ″.04, ″.04, ″.05, ″.04, ″.05, ″.04.

Diameter at fracture, 1″.04; area, .849 square inch.

Contraction of area, 15.1 per cent.

Fractured at the neck.

Appearance of fracture, dull silky, oblique; 10 per cent of surface dark brown, vesicular.

No. 8319.

Transverse specimen from bottom of ingot. Group of blowholes in stem, about ″.08 diameter each.
Marks, 25.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0014	0.	
10,000	.0032	.....	
30,000	.0103	0.	
35,000	.0121	.....	
36,000	.0128	.....	
37,000	.0132	.....	
38,000	.0140	.....	
39,000	.0147	.....	
40,000	.0157	.0019	
41,000	.0168	.....	
42,000	.0180	.....	
43,000	.0192	.....	
44,000	.0207	.....	
45,000	.0240	.0084	
46,000	.0292	.....	
48,000	.0487	.....	
50,000	.06	.....	
52,000	.13	.....	
56,000	.20	.....	
60,000	.28	.....	
64,000	.40	.....	
68,000	.59	.....	
72,000	.87	.....	
74,800	.....	.....	Tensile strength.
0	2.23	.....	=22.3 per cent elongation.

Elongation of inch sections, ″.10, ″.15, ″.18, ″.56*, ″.29, ″.20, ″.21, ″.20, ″.19, ″.15.
Diameter at fracture, ″.77; area, .466 square inch.
Contraction of area, 53.4 per cent.
Fractured 4″.75 from the neck.
Appearance of fracture, silky. Did not fracture at the group of blowholes.

No. 8320.

Longitudinal specimen, central.
Marks, 26.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0014	0.	
10,000	.0035	.....	
20,500	.....	.....	Tensile strength.

Elongation inappreciable.
Contraction of area inappreciable.
Fractured 1″.75 from the neck.
Appearance of fracture, light gray, vesicular, in part granular.

No. 8321.

Longitudinal specimen, central.
Marks, 27.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0013	0.	
10,000	.0030	.....	
30,000	.0112	.0010	
35,000	.0150	.....	
36,000	.0157	.....	
37,000	.0168	.....	
38,000	.0179	.....	
39,000	.0191	.....	
40,000	.0210	.0070	
41,000	.0235	.....	
42,000	.0259	.....	
43,000	.0286	.....	
44,000	.0338	.....	
45,000	.0382	.0220	
46,500	.....	.....	Tensile strength.
0	.09	.....	=0.9 per cent elongation.

Elongation of inch sections, 0″, ″.01, ″.04*, ″.02, ″.01, 0″, ″.01, 0″, 0″, 0″.
Diameter at fracture, 1″.11; area, .968 square inch.
Contraction of area, 3.2 per cent.
Fractured 3″ from the neck.
Appearance of fracture, coarse granular and light gray; amorphous.

No. 8322.

Longitudinal specimen, central; annealed.
Marks, 28.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0013	0.	
10,000	.0032	.....	
30,000	.0110	.0009	
35,000	.0140	.....	
36,000	.0147	.....	
37,000	.0153	.....	
38,000	.0162	.....	
39,000	.0178	.....	
40,000	.0210	.0078	
41,000	.0300	.....	
42,000	.0410	.....	
43,000	.0610	.....	
43,800	.....	.....	Tensile strength.
0	.16	.....	=1.6 per cent elongation.

Elongation of inch sections, ″.14*, 0″, 0″, 0″, ″.01, ″.01, 0″, 0″, 0″, 0″.
Diameter at fracture, 1″.07; area, .899 square inch.
Contraction of area, 10.1 per cent.
Fractured ″.7 from the neck.
Appearance of fracture, gray, silky, 70 per cent; light gray, amorphous, 30 per cent. Opened cracks in stem.

No. 8323.

Longitudinal specimen, central.
Marks, 29.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0015	0.	
10,000	.0032	.....	
30,000	.0121	.0018	
35,000	.0159	.....	
36,000	.0173	.....	
37,000	.0187	.....	
38,000	.0199	.....	
39,000	.0218	.....	
40,000	.0237	.0094	
41,000	.0261	.....	
42,000	.0282	.....	
43,000	.0327	.....	
44,000	.0370	.....	Opened cracks in stem.
46,000	.05	.....	
48,000	.07	.....	
49,900	.....	.....	Tensile strength.
0	.11	.....	=1.1 per cent elongation.

Elongation of inch sections, ″.01, 0″, ″.01, ″.02, 0″, ″.01, 0″, ″.01, 0″, ″.05*.

Diameter at fracture, 1″.11; area, .968 square inch.

Contraction of area, 3.2 per cent.

Fractured ″.75 from the neck.

Appearance of fracture, granular, 60 per cent; gray, amorphous, 40 per cent.

No. 8324.

Longitudinal specimen, central.
Marks, 30.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0014	0.	
10,000	.0032	.....	
30,000	.0117	.0012	
35,000	.0150	.....	
36,000	.0161	.....	
37,000	.0171	.....	
38,000	.0182	.....	
39,000	.0197	.....	
40,000	.0211	.0072	
41,000	.0235	.....	
42,000	.0250	.....	
43,000	.0279	.....	
44,000	.0302	.....	
45,000	.0345	.0185	Small crack in sight.
48,000	.06	.....	
50,000	.08	.....	
52,000	.11	.....	
56,000	.19	.....	
60,000	.28	.....	
64,000	.....	.....	Tensile strength.
0	.34	.....	=3.4 per cent elongation.

Elongation of inch sections, ″.02, ″.03, ″.04, ″.04, ″.03, ″.03, ″.04, ″.04, ″.03, ″.04.
Fractured in head, at root of thread.
Appearance of fracture, granular. Two cracks opened in stem.

No. 8325.

Longitudinal specimen, central; annealed.
Marks, 31.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0015	0.	
10,000	.0033	.....	
30,000	.0102	0.	
35,000	.0120	.....	
40,000	.0140	0.	
45,000	.0155	.....	
46,000	.0160	.....	
47,000	.0163	.....	
48,000	.0168	.....	
49,900	.0171	.....	
50,000	.0177	.0002	
51,000	.0182	.....	
52,000	.0193	.....	Elastic limit. Load fell.
47,000	.0295	.....	
48,000	.0340	.....	
49,000	.0480	.....	
50,000	.17	.....	Crack commences to open.
52,000	.22	.....	
56,000	.30	.....	
60,000	.41	.....	
64,000	.55	.....	
68,000	.76	.....	
73,100	.....	.....	Tensile strength.
0	1.33	.....	=13.3 per cent elongation.

Elongation of inch sections, ″.11, ″.20*, ″ .15, ″.12, ″.13, ″.12, ″.13, ″.12, ″.13, ″.12.

Diameter at fracture, 1″; area, .785 square inch.

Contraction of area, 21.5 per cent.

Fractured 2″.25 from the neck.

Appearance of fracture, silky. Opened cracks in stem in vicinity of place of rupture.

No. 8326.

Longitudinal specimen, central; bottom of ingot.
Marks, 32.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0017	.0002	
10,000	.0037	.0002	
30,000	.0112	.0011	
35,000	.0142	.....	
36,000	.0151	.....	
37,000	.0160	.....	
38,000	.0169	.....	
39,000	.0179	.....	
40,000	.0190	.0051	
41,000	.0201	.....	
42,000	.0213	.....	
43,000	.0234	.....	
44,000	.0261	.....	
45,000	.0315	.0158	
46,000	.0350	.....	
48,000	.0470	.....	
50,000	.06	.....	
52,000	.12	.....	
56,000	.20	.....	
60,000	.29	.....	
64,000	.40	.....	
68,000	.59	.....	
72,000	.91	.....	
74,000	.....	.....	Tensile strength.
0	1.52	.....	=15.2 per cent elongation.

Elongation of inch sections, ″.12, ″.13, ″.16, ″.24, ″.36*, ″.12, ″.10, ″.10, ″.10, ″.09.
Diameter at fracture, ″.91; area, .650 square inch.
Contraction of area, 35 per cent.
Fractured 5″.25 from the neck.
Appearance of fracture, silky.

No. 8327.

Longitudinal specimen, central; bottom of ingot.
Marks, 33.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inches.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0014	0.	
10,000	.0032	.....	
30,000	.0110	.0010	
35,000	.0142	.....	
40,000	.0198	.0060	
41,000	.0217	.....	
42,000	.0239	.....	
43,000	.0270	.....	
44,000	.0307	.....	
45,000	.0345	.0187	
46,000	.0390	.....	
48,000	.0570	.....	
50,000	.09	.....	
52,000	.13	.....	
56,000	.21	.....	
60,000	.30	.....	
64,000	.42	.....	
68,000	.62	.....	
72,000	1.01	.....	
73,300	.....	.....	Tensile strength.
0	1.74	.....	=17.4 per cent elongation.

Elongation of inch sections, ″.16, ″.43*, ″.24, ″.17, ″.17, ″.15, ″.12, ″.11, ″.10, ″.09.
Diameter of fracture, ″.88; area, .608 square inch.
Contraction of area, 39.2 per cent.
Fractured 1″.9 from the neck.
Appearance of fracture, silky.

No. 8328.

Transverse specimen.
Marks, 34.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0015	0.	
10,000	.0033	0.	
30,000	.0111	.0004	
35,000	.0139	.....	
40,000	.0171	.0030	
41,000	.0186	.....	
42,000	.0198	.....	
43,000	.0210	.....	
44,000	.0224	.....	
45,000	.0248	.0083	
46,000	.0270	.....	
47,000	.0300	.....	
48,000	.0332	.....	
50,000	.0453	.0270	
52,000	.08	.....	
56,000	.15	.....	
60,000	.24	.....	
64,000	.35	.....	
68,000	.52	.....	Crack opens in stem.
71,200	.....	.....	Tensile strength.
0	.70	.....	= 7 per cent elongation.

Elongation of inch sections, ″.06, ″.11*, ″.09, ″.07, ″.06, ″.07, ″.06, ″.06, ″.07, ″.05.

Diameter at fracture, 1″.08; area, .916 square inch.

Contraction of area, 8.4 per cent.

Fractured 1″.9 from the neck.

Appearance of fracture, granular, flaky. Opened oblique cracks in surface of stem.

No. 8329.

Transverse specimen, annealed.
Marks, 35.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0014	0.	
10,000	.0032	.....	
30,000	.0102	0.	
35,000	.0120	.....	
40,000	.0141	0.	
45,000	.0157	.....	
50,000	.0182	.0010	Elastic limit. Load fell.
47,000	.0343	.....	
48,000	.0356	.....	
49,000	.0400	.....	
50,000	.0700	.....	
52,000	.22	.....	Opens crack in stem.
56,000	.30	.....	
60,000	.41	.....	
64,000	.53	.....	
66,000	.....	.....	Tensile strength.
0	.68	.....	= 6.8 per cent elongation.

Elongation of inch sections, ″.18*, ″.06, ″.04, ″.06, ″.06, ″.05, ″.06, ″.06, ″.06, ″.05.

Diameter at fracture, 1″.02; area, .817 square inch.

Contraction of area, 18.3 per cent.

Fractured 1″ from the neck.

Appearance of fracture, silky. Opened oblique and longitudinal cracks in stem.

No. 8330.

Transverse specimen.
Marks, 36.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inches.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0015	0.	
10,000	.0032	.....	
30,000	.0109	.0003	
35,000	.0135	.....	
40,000	.0172	.0030	
41,000	.0182	.....	
42,000	.0193	.....	
43,000	.0203	.....	
44,000	.0216	.....	
45,000	.0243	.0081	
46,000	.0270	.....	
48,000	.0340	.....	
50,000	.0450	.....	
52,000	.07	.....	
56,000	.16	.....	
60,000	.25	.....	
64,000	.36	.....	
68,000	.55	.....	
72,000	.85	.....	
73,900	.....	.....	Tensile strength.
0	1.13	.....	=11.3 per cent elongation.

Elongation of inch sections, ″.09, ″.11, ″.08, ″.11, ″.11, ″.20*, ″.15, ″.11, ″.09, ″.08.

Diameter at fracture, 1″.02; area, .817 square inch.

Contraction of area, 18.3 per cent.

Fractured 5″ from the neck.

Appearance of fracture, granular; longitudinal seam at place of fracture.

No. 8331.

Transverse specimen.
Marks, 37.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0014	0.	
10,000	.0031	.....	
30,000	.0105	.0003	
35,000	.0130	.....	
40,000	.0168	.0028	
41,000	.0180	.....	
42,000	.0188	.....	
43,000	.0200	.....	
44,000	.0214	.....	
45,000	.0233	.0079	
46,000	.0260	.....	
48,000	.0332	.....	
50,000	.0460	.....	
52,000	.07	.....	Opens crack in stem.
56,000	.16	.....	
60,000	.26	.....	
63,600	.....	.....	Tensile strength.
0	.33	.....	=3.3 per cent elongation.

Elongation of inch sections, ″.03, ″.02, ″.03, ″.04, ″.03, ″.02, ″.03, ″.02, ″.09*, ″.02.

Diameter at fracture, 1″.10; area, .950 square inch.

Contraction of area, 5 per cent.

Fractured 1″.4 from the neck.

Appearance of fracture, coarse granular, flaky. Fractured at an oblique seam.

No. 8332.

Transverse specimen.
Marks, 38.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0013	0.	
10,000	.0032	.....	
30,000	.0108	.0004	
35,000	.0133	.0012	
40,000	.0171	.0030	
41,000	.0184	.....	
42,000	.0191	.....	
43,000	.0205	.....	
44,000	.0218	.....	
45,000	.0243	.0083	
46,000	.0268	.....	
47,000	.0290	.....	
48,000	.0330	.....	
50,000	.0450	.....	
52,000	.07	.....	
56,000	.16	.....	
60,000	.24	.....	
64,000	.36	.....	Longitudinal seams open in stem.
68,000	.55	.....	
72,000	.....	.....	Tensile strength.
0	.92	.....	=9.2 per cent elongation.

Elongation of inch sections, ″.12*, ″.09, ″.08, ″.10, ″.09, ″.10, ″.08, ″.09, ″.09, ″.08.

Diameter at fracture, 1″.07; area, .899 square inch.

Contraction of area, 10.1 per cent.

Fractured ″.5 from the neck.

Appearance of fracture, coarse granular, flaky. Opened longitudinal and oblique cracks in stem.

No. 8333.

Transverse specimen, annealed.
Marks, 39.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inches.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0017	.0001	
10,000	.0036	.0001	
30,000	.0108	.0001	
35,000	.0124	.....	
40,000	.0143	.0001	
45,000	.0159	.0003	
50,000	.0180	.0004	
51,000	.0184	.....	
52,000	.0190	.....	
53,000	.0197	.....	Elastic limit. Load fell.
49,000	.0270	.....	
50,000	.0362	.....	
51,000	.0850	.....	
52,000	.19	.....	
56,000	.29	.....	
60,000	.39	.....	Crack opens in stem.
64,000	.53	.....	
68,000	.73	.....	
71,500	.....	.....	Tensile strength.
0	1.05	.....	=10.5 per cent elongation.

Elongation of inch sections, ″.08, ″.09, ″.08, ″.09, ″.09, ″.09, ″.09, ″.13, ″.21*, ″.10.

Diameter at fracture, ″.95; area, .709 square inch.

Contraction of area, 29.1 per cent.

Fractured 2″ from the neck.

Appearance of fracture, silky. Opened oblique and longitudinal seams in stem in nine places.

No. 8334.

Transverse specimen.
Marks, 40.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0015	0.	
10,000	.0035	.....	
30,000	.0110	.0003	
35,000	.0133	.....	
40,000	.0169	.0030	
41,000	.0180	.....	
42,000	.0193	.....	
43,000	.0205	.....	
44,000	.0223	.....	
45,000	.0253	.0090	
46,000	.0278	.....	
48,000	.0340	.....	
50,000	.0460	.....	
52,000	.08	.....	
56,000	.17	.....	Opened cracks in stem.
60,000	.25	.....	
63,400	.....	.....	Tensile strength.
0	.31	.....	=3.1 per cent elongation.

Elongation of inch sections, ″.08*, ″.02, ″.02, ″.04, ″.03, ″.03, ″.03, ″.02, ″.02, ″.02.

Diameter at fracture, 1″.09; area, .933 square inch.

Contraction of area, 6.7 per cent.

Fractured 1″.1 from the neck.

Appearance of fracture, coarse granular, flaky. Ruptured at an oblique seam in the stem.

No. 8335.

Transverse specimen.
Marks, 41.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0014	0.	
10,000	.0032	.....	
30,000	.0109	.0002	
35,000	.0135	.....	
40,000	.0170	.0030	
42,000	.0191	.....	
44,000	.0220	.....	
45,000	.0255	.0091	
46,000	.0286	.....	
48,000	.0350	.....	
50,000	.0510	.....	
52,000	.08	.....	Crack opens in stem.
56,000	.17	.....	
60,000	.26	.....	
64,000	.39	.....	
68,000	.57	.....	
69,800	.....	.....	Tensile strength.
0	.64	.....	= 6.4 per cent elongation.

Elongation of inch sections, ″.06, ″.05, ″.13*, ″.07, ″.05, ″.06, ″.06, ″.06, ″.05, ″.05.
Diameter at fracture, 1″.06; area, .882 square inch.
Contraction of area, 11.8 per cent.
Fractured 3″ from the neck.
Appearance of fracture, coarse granular, flaky.

No. 8336.

Longitudinal specimen.
Marks, 42.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0012	0.	
10,000	.0031	.....	
30,000	.0104	0.	
35,000	.0125	.....	
40,000	.0151	.0010	
41,000	.0154	.....	
42,000	.0159	.....	
43,000	.0170	.....	
44,000	.0178	.....	
45,000	.0188	.0030	
46,000	.0198	.....	
47,000	.0208	.....	
48,000	.0225	.....	
49,000	.0250	.....	
50,000	.0290	0109	
52,000	.04	.....	
56,000	.09	.....	Crack opens in stem.
56,200	.....	.....	Tensile strength.
0	.11	.....	=1.1 per cent elongation.

Elongation of inch sections, ″.01, ″.01, 0″, ″.01, ″.01, ″.01, ″.01, ″.01, ″.01, ″.03*.
Diameter at fracture, 1″.12; area, .985 square inch.
Contraction of area, 1.5 per cent.
Fractured ″.7 from the neck.
Appearance of fracture, coarse granular, flaky.

No. 8337.

Longitudinal specimen, annealed.
Marks, 43.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0015	0.	
10,000	.0032	.....	
30,000	.0104	.0001	
35,000	.0121	.....	
40,000	.0140	.0002	
45,000	.0162	.0009	
46,000	.0170	.....	
47,000	.0179	.....	
48,000	.0188	.....	Elastic limit. Load fell.
45,000	.0208	.....	
46,000	.0225	.....	
47,000	.0325	.....	
48,000	.0378	.....	
50,000	.0600	.....	Opened a crack in stem.
52,000	.23	.....	
56,000	.32	.....	
59,600	.....	.....	Tensile strength.
0	.51	.....	=5.1 per cent elongation.

Elongation of inch sections, ″.21*, ″.02, ″.03, ″.04, ″.04, ″.03, ″.03, ″.04, ″.04, ″.03.

Diameter at fracture, 1″.04; area, .849 square inch.

Contraction of area, 15.1 per cent.

Fractured ″.4 from the neck.

Appearance of fracture, silky; blue-black, amorphous spot at circumference. Opened seven cracks in stem.

No. 8338.

Longitudinal specimen.
Marks, 44.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0012	0.	
10,000	.0030	.....	
30,000	.0102	0.	
35,000	.0125	.....	
40,000	.0151	.0015	
41,000	.0160	.....	
42,000	.0168	.....	
43,000	.0176	.....	
44,000	.0187	.....	
45,000	.0200	.0048	
46,000	.0213	.....	
47,000	.0229	.....	
48,000	.0250	.....	
49,000	.0269	.....	
50,000	.0315	.0135	
52,000	.06	.....	Opened crack in stem.
56,000	.12	.....	
60,000	.21	.....	
64,000	.31	.....	
66,400	.....	.....	Tensile strength.
0	.31	.....	=3.1 per cent elongation.

Elongation of inch sections, ″.04, ″.04, ″.02, ″.03. ″.03, ″.03, ″.03, ″.03, ″.03, ″.03.

Diameter at fracture, 1″.10; area, .950 square inch.

Contraction of area, 5 per cent.

Fractured at the neck.

Appearance of fracture, coarse granular, 85 per cent; smooth, lustrous, 15 per cent. Opened cracks in stem in six places.

No. 8339.

Longitudinal specimen.
Marks, 45.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0012	0.	
10,000	.0029	.....	
30,000	.0111	.0002	
37,100	.....	.....	Tensile strength.

Elongation inappreciable.
Contraction of area inappreciable.
Fractured ″.9 from the neck.
Appearance of fracture, coarse granular, 70 per cent; blue-black, amorphous, 30 per cent.

No. 8340.

Longitudinal specimen.
Marks, 46.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0011	0.	
10,000	.0028	.....	
30,300	.....	.....	Tensile strength.

Elongation inappreciable.
Contraction of area inappreciable.
Fractured at the neck.
Appearance of fracture, coarse granular, 50 per cent; dark brown, amorphous, 50 per cent.

No. 8341.

Longitudinal specimen, annealed.
Marks, 47.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0013	0.	
10,000	.0031	.....	
30,000	.0102	0.	
35,000	.0129	.....	
40,000	.0192	.0052	Opened crack in stem.
45,000	.06	.....	
51,000	.....	.....	Tensile strength.
0	.24	.....	=2.4 per cent elongation.

Elongation of inch sections, ″.02, ″.02, ″.06*, ″.05, ″.02, ″.01, ″.02, ″.01, ″.02, ″.01.

Diameter at fracture, 1″.07; area, .899 square inch.

Contraction of area, 10.1 per cent.

Fractured 3″.1 from the neck.

Appearance of fracture, coarse granular, 60 per cent; smooth, lustrous, 40 per cent.

No. 8342.

Longitudinal specimen.
Marks, 48.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0013	0.	
10,000	.0031	.....	
30,000	.0109	.0007	
35,000	.0136	.....	
40,000	.0182	.0042	
41,000	.0200	.....	
42,000	.0212	.....	
43,000	.0226	.....	
44,000	.0250	.....	
45,000	.0275	.0115	
48,000	.05	.....	
50,000	.07	.....	
52,000	.10	.....	
56,000	.16	.....	Opens cracks in stem.
59,800	.....	.....	Tensile strength.
0	.24	.....	=2.4 per cent elongation.

Elongation of inch sections, ″.02, ″.03, ″.05*, ″.02, ″.03, ″.02, ″.02, ″.01, ″.02, ″.02.

Diameter at fracture, 1.″11; area, .968 square inch.

Contraction of area, 3.2 per cent.

Fractured 3″ from the neck.

Appearance of fracture, coarse granular. Opened cracks in the stem in four places.

No. 8343.

Longitudinal specimen.
Marks, 49.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0013	0.	
10,000	.0031	.....	
30,000	.0117	.0011	
35,000	.0160	.....	
40,000	.....	.....	Tensile strength.

Elongation hardly appreciable.

Contraction of area inappreciable.

Fractured 3″.15 from the neck.

Appearance of fracture, coarse granular, 60 per cent; smooth lustrous, 40 per cent.

No. 8344.

Transverse specimen.
Marks, 50.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0013	0.	
10,000	.0031	.....	
30,000	.0106	.0001	
35,000	.0130	.....	
40,000	.0165	.0022	
41,000	.0176	.....	
42,000	.0183	.....	
43,000	.0192	.....	
44,000	.0210	.....	
45,000	.0230	.0070	
46,000	.0243	.....	
47,000	.0269	.....	
48,000	.0300	.....	
50,000	.0390	.....	
52,000	.07	.....	Longitudinal crack opened.
56,000	.14	.....	
60,000	.22	.....	
63,900	.....	.....	Tensile strength.
0	.36	.....	= 3.6 per cent elongation.

Elongation of inch sections, ″.03, ″.02, ″.03, ″.03, ″.03, ″.10*, ″.04, ″.03, ″.02, ″.03.

Diameter at fracture, 1″.10; area, .950 square inch.

Contraction of area, 5 per cent.

Fractured 4″.9 from the neck.

Appearance of fracture, coarse granular, 90 per cent; seamy, oblique, 10 per cent.

No. 8345.

Transverse specimen, annealed.
Marks, 51.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0014	0.	
10,000	.0030	.....	
30,000	.0102	0.	
35,000	.0128	.....	
40,000	.0153	.0014	
41,000	.0165	.....	
42,000	.0182	.....	
43,000	.0201	.....	
44,000	.0220	.....	
45,000	.0290	.0130	
46,000	.0590	.....	
47,000	.0740	.....	
48,000	.10	.....	
50,000	.15	.....	
52,000	.22	.....	
56,000	.30	.....	
60,000	.39	.....	
64,000	.54	.....	
68,000	.....	.....	Tensile strength.
0	.84	.....	=8.4 per cent elongation.

Elongation of inch sections, ″.08, ″.19*, ″.09, ″.07, ″.07, ″.08, ″.07, ″.06, ″.08, ″.05.
Diameter at fracture, ″.98; area, .754 square inch.
Contraction of area, 24.6 per cent.
Fractured 1″.75 from the neck.
Appearance of fracture, silky, with light, silvery, lustrous spot.

No. 8346.

Transverse specimen.
Marks, 52.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0013	0.	
10,000	.0031	.....	
30,000	.0108	.0002	
35,000	.0130	.....	
40,000	.0160	.0023	
41,000	.0175	.....	
42,000	.0187	.....	
43,000	.0198	.....	
44,000	.0205	.....	
45,000	.0228	.0069	
46,000	.0245	.....	
47,000	.0268	.....	
48,000	.0290	.....	
49,000	.0340	.....	
50,000	.0390	.0208	
52,000	.07	.....	
56,000	.13	.....	
60,000	.23	.....	Opened crack in stem.
64,000	.34	.....	
66,800	.....	.....	Tensile strength.
0	.41	.....	=4.1 per cent elongation.

Elongation of inch sections, ″.03, ″.05, ″.03, ″.03, ″.10*, ″.03, ″.05, ″.03, ″.03, ″.03.

Diameter at fracture, 1″.10; area, .950 square inch.

Contraction of area, 5 per cent.

Fractured 5″ from the neck.

Appearance of fracture, coarse granular; dark colored, seamy spot at circumference. Opened cracks in stem in five places.

No. 8347.

Transverse specimen, annealed.
Marks, 53.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0015	0.	
10,000	.0032	.....	
30,000	.0102	0.	
35,000	.0120	.....	
40,000	.0140	0.	
45,000	.0158	.0001	
46,000	.0167	.....	
47,000	.0172	.....	
48,000	.0180	.....	Elastic limit.
49,000	.0415	.....	
50,000	.0620	.0442	
52,000	.20	.....	
56,000	.30	.....	Opened cracks in stem.
60,000	39	.....	
64,000	.53	.....	
68,000	.75	.....	
71,000	.....	.....	Tensile strength.
0	1.00	.....	= 10 per cent elongation.

Elongation of inch sections, ″.09, ″.09, ″.08, ″.13, ″.19*, ″.09, ″.09, .08, ″.07, ″.09.
Diameter at fracture, ″.98; area, .754 square inch.
Contraction of area, 24.6 per cent.
Fractured 4″.75 from the neck.
Appearance of fracture, silky. Opened cracks in stem in six places.

No. 8348.

Transverse specimen.
Marks, 54.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0014	0.	
10,000	.0032	.....	
30,000	.0108	.0002	
35,000	.0132	.0010	
40,000	.0170	.0029	
41,000	.0182	.....	
42,000	.0195	.....	
43,000	.0210	.....	
44,000	.0230	.....	
45,000	.0258	.0095	
46,000	.0285	.....	
47,000	.0318	.....	Opened oblique crack in stem.
48,200	.....	.....	Tensile strength.
0	.10	.....	= 1 per cent elongation.

Diameter at fracture, 1″.11; area, .968 square inch.
Contraction of area, 3.2 per cent.
Fractured 3″.30 from the neck.
Appearance of fracture, coarse granular; in part smooth, lustrous, oblique.

No. 8349.

Longitudinal specimen.
Marks, 55.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0014	0.	
10,000	.0033	.....	
30,000	.0108	0.	
35,000	.0129	.0004	
40,000	.0156	.0017	
41,000	.0165	.....	
42,000	.0174	.....	
43,000	.0184	.....	
44,000	.0198	.....	
45,000	.0212	.0061	
46,000	.0229	.....	
47,000	.0249	.....	
48,000	.0272	.....	
49,000	.0300	.....	
50,000	.0360	.0174	
52,000	.06	.....	
56,000	.12	.....	
60,000	.20	.....	
64,000	.31	.....	
68,000	.44	.....	
72,000	.67	.....	
76,000	.....	.....	Tensile strength.
0	1.71	.....	=17.1 per cent elongation.

Elongation of inch sections, ″.10, ″.17, ″.32*, ″.32*, ″.16, ″.13, ″.15, ″.14, ″.11, ″.11.
Diameter at fracture, ″.92; area, .665 square inch.
Contraction of area, 33.5 per cent.
Fractured 3″.5 from the neck.
Appearance of fracture, silky, interspersed with granular metal.

NO. 8349.

HARMET STEEL INGOT.

APPEARANCE OF STEM OF SPECIMEN AFTER FRACTURE, SHOWING OBLIQUE LINES
REVEALING THE COLUMNAR STRUCTURE OF THE INGOT.

CAMPBELL ART CO.
ELIZABETH, N. J.

No. 8350.

Longitudinal specimen.
Marks, 56.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0013	0.	
10,000	.0032	.....	
30,000	.0106	.0001	
35,000	.0130	.0006	
40,000	.0168	.0029	
41,000	.0180	.....	
42,000	.0189	.....	
43,000	.0199	.....	
44,000	.0216	.....	
45,000	.0237	.0078	
46,000	.0260	.....	
47,000	.0287	.....	
48,000	.0315	.....	
49,000	.0342	.....	
50,000	.0422	.0240	
52,000	.06	.....	Opened crack at neck.
53,800	.....	.....	Tensile strength.
0	.07	....	=0.7 per cent elongation.

Contraction of area inappreciable.
Fractured 1″ from the neck.
Appearance of fracture, coarse granular, flaky.

No. 8351.

Longitudinal specimen, annealed.
Marks, 57.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0014	0.	
10,000	.0032	.....	
30,000	.0104	.0001	
35,000	.0125	.....	
40,000	.0147	.0003	
41,000	.0157	.....	
42,000	.0185	.....	
43,000	.0225	.....	
44,000	.0289	.....	
45,000	.0350	.0180	Opened crack in stem.
47,700	.....	.....	Tensile strength.
0	.14	.....	= 1.4 per cent elongation.

Diameter at fracture, 1″.08; area, .916 square inch.
Contraction of area, 8.4 per cent.
Fractured 1″.2 from the neck.
Appearance of fracture, silky, 70 per cent; blue-black, amorphous, 30 per cent.

No. 8352.

Longitudinal specimen.
Marks, 58.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0011	0.	
10,000	.0030	.....	
30,000	.0102	0.	
35,000	.0127	.0010	
40,000	.0168	.0030	
41,000	.0181	.....	
42,000	.0190	.....	
43,000	.0202	.....	
44,000	.0218	.....	
45,000	.0238	.0081	
46,000	.0265	.....	
47,000	.0282	.....	
48,000	.0334	.....	
49,000	.03 0	.....	
50,000	.0455	.0277	
52,000	.07	.....	
56,000	.15	.....	Open crack in stem.
60,000	.24	.....	
64,000	.35	.....	
68,000	.51	.....	
69,900	.....	.....	Tensile strength.
0	.57	.....	= 5.7 per cent elongation.

Elongation of inch sections, ″.05, ″.05, ″.06, ″.07*, ″.07, ″.05, ″.05, ″.06, ″.05, ″.06.

Diameter at fracture, 1″.08; area, .916 square inch.

Contraction of area, 8.4 per cent.

Fractured 3″.75 from the neck.

Appearance of fracture, coarse granular; oblique, seamy spot at circumference.

No. 8353.

Longitudinal specimen.
Marks, 59.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inches.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0017	0.	
10,000	.0031	.....	
30,000	.0108	.0002	
35,000	.0130	.0011	
40,000	.0168	.0031	
41,000	.0182	.....	
42,000	.0197	.....	
43,000	.0212	.....	
44,000	.0230	.....	
45,000	.0255	.0099	
46,000	.0279	.....	
47,000	.0300	.....	
48,000	.0340	.....	
49,000	.0420	.....	
50,000	.0500	.0320	
52,000	.08	.....	
56,000	.15	.....	
60,000	.25	.....	
64,000	.35	.....	
68,000	.52	.....	
72,000	.89	.....	
74,800	.....	.....	Tensile strength.
0	1.81	.....	=18.1 per cent elongation.

Elongation of inch sections, ″.10, ″.13, ″.34*, ″.25*, ″.18, ″.20, ″.20, ″.16, ″.13, ″.12.
Diameter at fracture, ″.92; area, .665 square inch.
Contraction of area, 33.5 per cent.
Fractured 3″.5 from the neck.
Appearance of fracture, silky, interspersed with granular metal.

No. 8354.

Longitudinal specimen.
Marks, 60.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inches.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0012	0.	
10,000	.0030	.....	
30,000	.0103	.0001	
35,000	.0130	.0010	
40,000	.0173	.0033	
41,000	.0188	.....	
42,000	.0200	.....	
43,000	.0214	.....	
44,000	.0235	.....	
45,000	.0260	.0100	
46,000	.0300	.....	
47,000	.0340	.....	
48,000	.0380	.....	
49,000	.0460	.....	
50,000	.0580	.0397	Opened crack in stem.
52,000	.09	.....	
56,000	.17	.....	
60,000	.27	.....	
64,000	.39	.....	
68,000	.55	.....	
72,000	.86	.....	
74,100	.....	.....	Tensile strength.
0	1.41	.....	=14.1 per cent elongation.

Elongation of inch sections, ″.10, ″.14, ″.16, ″.30*, ″.16, ″.16, ″.13, ″.11, ″.08, ″.07.
Diameter at fracture, ″.98; area, .754 square inch.
Contraction of area, 24.6 per cent.
Fractured 4″.25 from the neck.
Appearance of fracture, granular; seamy spot at circumference.

No. 8355.

Longitudinal specimen, annealed.
Marks, 61.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0010	0.	
10,000	.0029	.....	
30,000	.0097	0.	
35,000	.0113	0.	
40,000	.0135	0.	
45,000	.0155	0.	
46,000	.0159	.....	
47,000	.0165	.....	
48,000	.0169	.....	Elastic limit. Load fell.
45,000	.0251	.....	Cracks opened in stem.
46,000	.0275	.....	
47,000	.0340	.....	
48,000	.1050	.....	
50,000	.19	.....	
52,000	.24	.....	
56,000	.34	.....	
60,000	.45	.....	
64,000	.61	.....	
68,000	.....	.....	Tensile strength.
0	.93	.....	=9.3 per cent elongation.

Elongation of inch sections, ″.08, ″.08, ″.08, ″.08, ″.09, ″.08, ″.11, ″.18*, ″.08, ″.07.

Diameter at fracture, 1″.02; area, .817 square inch.

Contraction of area, 18.3 per cent.

Fractured 3″ from the neck.

Appearance of fracture, silky. Opened cracks in stem in three places.

No. 8356.

Longitudinal specimen.
Marks, 62.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0014	0.	
10,000	.0030	.....	
30,000	.0113	.0011	
35,000	.0147	.0023	
36,000	.0155	.....	
37,000	.0165	.....	
38,000	.0175	.....	
39,000	.0180	.....	
40,000	.0202	.0060	
41,000	.0228	.....	
42,000	.0240	.....	
43,000	.0265	.....	
44,000	.0295	.....	
45,000	.0344	.0182	
46,000	.0400	.....	
47,000	.0480	.....	
48,000	.0560	.....	
50,000	.09	.....	
52,000	.13	.....	
56,000	.21	.....	
60,000	.32	.....	Oblique crack in stem.
64,000	.45	.....	
68,000	.66	.....	Tensile strength.
0	.68	.....	=6.8 per cent elongation.

Elongation of inch sections, ″.06, ″.07, ″.06, ″.07, ″.06, ″.06, ″.05, ″.06, ″.05, ″.14*.

Diameter at fracture, 1″.05; area, .866 square inch.

Contraction of area, 13.4 per cent.

Fractured 1″ from the neck.

Appearance of fracture, coarse granular, 85 per cent; smooth, lustrous, oblique, 15 per cent.

No. 8357.

Longitudinal specimen.
Marks, 63.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0014	0.	
10,000	.0031	.....	
30,000	.0112	.0010	
35,000	.0145	.0027	
36,000	.0157	.....	
37,000	.0169	.....	
38,000	.0177	.....	
39,000	.0190	.....	
40,000	.0208	.0069	
41,000	.0231	.....	
42,000	.0250	.....	
43,000	.0272	.....	
44,000	.0300	.....	
45,000	.0355	.0192	
46,000	.0440	.....	
48,000	.07	.....	
50,000	.09	.....	
52,000	.13	.....	
56,000	.21	.....	
60,000	.30	.....	
64,000	.44	.....	Oblique crack in stem.
68,000	.61	.....	
70,900	.....	.....	Tensile strength.
0	.84	.....	=8.4 per cent elongation.

Elongation of inch sections, ″.12*, ″.09, ″.09, ″.10, ″.08, ″.07, ″.07, ″.08, ″.07, ″.07.

Diameter at fracture, 1″.06; area, .882 square inch.

Contraction of area, 11.8 per cent.

Fractured 1″ from the neck.

Appearance of fracture, coarse granular. Seamy spot at circumference.

No. 8358.

Longitudinal specimen from edge of slice, annealed.
Marks, 64.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inches.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0010	0.	
10,000	.0029	.....	
30,000	.0100	0.	
35,000	.0119	0.	
40,000	.0138	0.	
45,000	.0155	0.	
46,000	.0160	.....	
47,000	.0163	.....	
48,000	.0167	.....	Elastic limit.
49,000	.0182	.....	Load fell.
47,000	.0300	.....	
48,000	.0450	.....	
49,000	.0900	.....	
50,000	.23	.....	
52,000	.26	.....	
56,000	.36	.....	
60,000	.48	.....	
64,000	.66	.....	
68,000	.92	.....	Tensile strength.
0	1.05	.....	=10.5 per cent elongation.

Elongation of inch sections, ″.08, ″.09, ″.09, ″.10, ″.22*, ″.12, ″.10, ″.10, ″.08, ″.07.

Diameter at fracture, ″.98; area, .754 square inch.

Contraction of area, 24.6 per cent.

Fractured 5″.75 from the neck.

Appearance of fracture, silky. Fractured at a group of three blowholes. There were 48 blowholes in the stem of this specimen, their diameter ranging from ″.02 to ″.05 each.

No. 8359.

Longitudinal specimen from edge of slice.
Marks, 65.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0013	0.	
10,000	.0030	.....	
30,000	.0101	0.	
35,000	.0120	0.	
40,000	.0140	0.	
41,000	.0147	.....	
42,000	.0152	.....	
43,000	.0163	.....	
44,000	.0178	.....	
45,000	.0205	.0044	
46,000	.0241	.....	
47,000	.0280	.....	
48,000	.0330	.....	
49,000	.0450	.....	
50,000	.0660	.0472	
52,000	.11	.....	
56,000	.20	.....	
60,000	.29	.....	
64,000	.43	.....	
68,000	.65	.....	
69,600	.....	.....	Tensile strength.
0	.76	.....	=7.6 per cent elongation.

Elongation of inch sections, ″.07, ″.04, ″.08, ″.07, ″.09, ″.11*, ″.10, ″.06, ″.08, ″.06.

Diameter at fracture, 1″.05; area, .866 square inch.

Contraction of area, 13.4 per cent.

Fractured 4″.75 from the neck.

Appearance of fracture, granular. One side of stem thickly studded with blow holes, ″.03 to ″.06 diameter.

No. 8360.

Longitudinal specimen from edge of slice.
Marks, 66.
Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0012	0.	
10,000	.0030	.....	
30,000	.0105	0.	
35,000	.0127	0.	
38,000	.0142	.....	
39,000	.0157	.....	
40,000	.0210	.0061	
41,000	.0250	.....	
42,000	.0330	.....	
43,000	.0472	.....	
43,900	.....	.....	Tensile strength.
0	.13	.....	=1.3 per cent elongation.

Diameter at fracture, 1″.11; area, .968 square inch.
Contraction of area, 3.2 per cent.
Fractured 1″ from the neck.
Appearance of fracture, granular, 45 per cent; spongy, 55 per cent.

TABULATION OF TENSILE SPECIMENS FROM HARMET STEEL INGOT.

SPECIMENS TAKEN FROM LOWER HALF OF INGOT.

Diameter of specimens, 1″.129. Length of stems, 10″.

No. of test.	Marks.	Description.	Treatment.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation in 10 inches.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
				Pounds.	*Pounds.*	*Per ct.*	*Per ct.*	″ ″ ″ ″ ″ ″ ″ ″ ″ ″	
8295	1	Longitudinal specimen, from edge of slice.	.....	(a)	75,100	13.2	18.3	.09, .13, .11, .15, .25*, .14, .12, .12, .12, .09	Dull gray, amorphous. Cavities in stem.
8296	2	.....do.....	Annealed.	51,000	74,000	25.2	51.0	.15, .19, .23, .25, .26, .55*, .35, .22, .19, .13	Silky; opened cracks in stem.
8297	3	.....do.....	.....	(a)	73,800	19.3	32.1	.13, .15, .17, .19, .20, .37*, .25, .19, .15, .13	Dull gray, amorphous; lighter colored spots.
8298	4	Transverse specimen.....	.....	(a)	72,000	11.7	19.9	.09, .11, .08, .25*, .09, .10, .11, .13, .12, .09	Dull gray, in part granular; opened oblique cracks.
8299	5	.....do.....	Annealed.	48,000	74,800	20.9	40.6	.16, .28, .47*, .23, .18, .17, .17, .14, .15, .14	Silky; opened cracks in stem.
8300	6	.....do.....	.....	(a)	73,000	16.2	24.6	.10, .13, .17, .20, .18, .11, .12, .14, .26*, .21*	Dull gray, in part granular.
8301	7	.....do.....	.....	(a)	73,600	16.9	26.1	.10, .11, .13, .12, .14, .31*, .30*, .17, .17, .14	Silky and granular metal interspersed.
8302	8	.....do.....	.....	(a)	63,200	3.3	5.0	.02, .03, .07*, .04, .03, .02, .04, .02, .03, .03	Coarse granular.
8303	9	.....do.....	Annealed.	52 000	74,100	14.7	21.5	.11, .13, .14, .14, .15, .14, .15, .15, .23*, .13	Silky, irregular; opened cracks in stem.
8304	10	.....do.....	.....	(a)	58,200	2.1	5.0	.02, .06*, .02, .02, .02, .02, .02, .01, .01, .01	Coarse granular, flaky.
8305	11	.....do.....	.....	(a)	73,800	14.6	36.4	.09, .09, .10, .14, .13, .11, .10, .14, .35*, .21	Silky, trace of granulation.
8306	12	Longitudinal specimen.....	.....	(a)	54,800	0.9	(b)	.01, 0, .01, .04*, 0, 0, .01, .01, 0, .01	Coarse granular.
8307	13	.....do.....	Annealed.	(a)	32,700	(b)	(b)	.....	Silky, 40 per cent; blue-black, amorphous, 60 per cent. Cracks opened in stem.
8308	14	.....do.....	.....	(a)	50,800	1.2	5.0	.01, .01, .01, .01, .04*, .02, .01, 0, 0, .01	Coarse granular, 60 per cent; smooth lustrous, 40 per cent. Cracks opened in stem in 6 places.
8309	15	.....do.....	Annealed.	(a)	37,000	(b)	(b)	.....	Silky, 50 per cent; blue-black, amorphous, 50 per cent. Opened cracks in surface of stem.
8310	16	.....do.....	.....	(a)	44,900	(b)	(b)	.....	Coarse granular, 80 per cent; blue-black, amorphous, 20 per cent. Opened cracks in 4 places.

8311	17	Transverse specimen		(a)	71,400	8.1	11.8		Coarse granular.
8312	18	do		(a)	73,000	10.9	10.1	.14*, .09, .08, .09, .10, .09, .11, .17, .12, .10	Coarse granular; opened oblique seams.
8313	19	do	Annealed.	48,000	73,600	18.0	30.6	.12, .13, .16, .17, .22, .34*, .21, .18, .15, .12	Silky; opened 2 oblique cracks in stem.
8314	20	do		(a)	73,000	11.0	13.4	.09, .09, .08, .17*, .14, .11, .10, .11, .12, .09	Dull gray, amorphous, in part granular.
8315	21	do		(a)	73,700	15.3	37.8	.11, .17, .41*, .20, .10, .10, .11, .12, .12, .09	Silky, trace of granulation. Opened cracks in stem.
8316	22	do		(a)	73,600	14.8	15.1	.13, .17, .15, .16, .13, .12, .21*, .18, .14, .09	Coarse granular. Opened cracks in stem.
8317	23	do		(a)	47,100	0.6	(b)	0, .04*, .01, .01, 0, 0, 0, 0, 0, 0	Coarse granular, 70 per cent; blue-black, amorphous, 30 per cent.
8318	24	do	Annealed.	46,000	62,600	5.0	15.1	.09*, .05, .04, .06, .04, .04, .05, .04, .05, .04	Dull silky, oblique; 10 per cent of surface dark brown, vesicular.
8319	25	Transverse specimen, from bottom of ingot.		(a)	74,800	22.3	53.4	.10, .15, .18, .56*, .29, .20, .21, .20, .19, .15	Silky. Group of blowholes in stem.
8320	26	Longitudinal specimen, central.		(a)	20,500	(b)	(b)		Light gray, vesicular, in part granular.
8321	27	do		(a)	46,500	0.9	3.2	0, .01, .04*, .02, .01, 0, .01, 0, 0, 0	Coarse granular and light gray; amorphous.
8322	28	do	Annealed.	(a)	43,800	1.6	10.1	.14*, 0, 0, 0, .01, .01, 0, 0, 0, 0	Gray, silky, 70 per cent; light gray, amorphous, 30 per cent. Opened cracks in stem.
8323	29	do		(a)	40,900	1.1	3.2	.01 0, .01, .02, 0, .01, 0, .01, 0, .05*	Granular, 60 per cent; gray, amorphous, 40 per cent.
8324	30	do		(a)	64,000	3.4	.....	.02, .03, .04, .04, .03, .03, .04, .04, .03, .04	Granular; 2 cracks opened in stem. Fractured in head, at root of thread.
8325	31	do	Annealed.	52,000	73,100	13.3	21.5	.11, .20*, .15, .12, .13, .12, .13, .12, .13, .12	Silky. Opened cracks in stem.
8326	32	Longitudinal specimen, central, from bottom of ingot.		(a)	74,000	15.2	35.0	.12, .13, .16, .24, .36*, .12, .10, .10, .10, .09	Silky.
8327	33	do		(a)	73,300	17.4	39.2	.16, .43*, .24, .17, .17, .15, .12, .11, .10, .09	Do.
8328	34	Transverse specimen		(a)	71,200	7.0	8.4	.06, .11*, .09, .07, .06, .07, .06, .06, .07, .05	Granular, flaky. Opened oblique cracks in surface of stem.
8329	35	do	Annealed.	50,000	66,000	6.8	18.3	18*, .06, .04, .06, .06, .05, .06, .06, .06, .05	Silky. Opened oblique and longitudinal cracks in stem.
8330	36	do		(a)	73,900	11.3	18.3	.09, .11, .08, .11, .11, .20*, .15, .11, .09, .08	Granular; longitudinal seam at place of fracture.
8331	37	do		(a)	63,600	3.3	5.0	.03, .02, .03, .04, .03, .02, .03, .02, .09*, .02	Coarse granular, flaky. Fractured at an oblique seam.
8332	38	do		(a)	72,000	9.2	10.1	.12*, .09, .08, .10, .09, .10, .08, .09, .09, .08	Coarse granular, flaky. Opened longitudinal and oblique cracks in stem.

a Indefinite.

b Inappreciable.

TABULATION OF TENSILE SPECIMENS FROM HARMET STEEL INGOT—Continued.

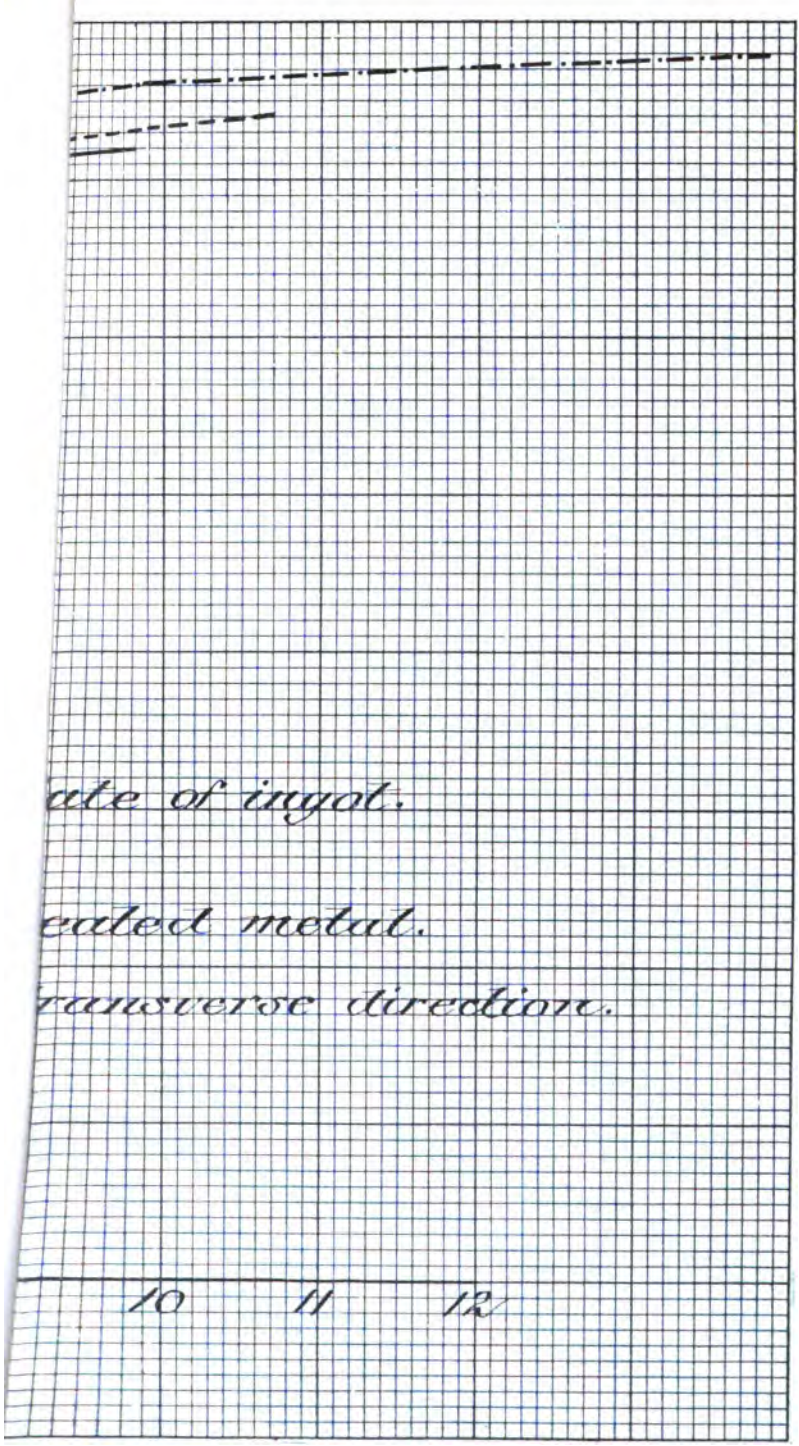
SPECIMENS TAKEN FROM LOWER HALF OF INGOT—Continued.

No. of test.	Marks.	Description.	Treatment.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation in 10 inches.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
				Pounds.	*Pounds.*	*Per ct.*	*Per ct.*	" " " " " " " " " "	
8333	39	Transvere specimen.....	Annealed.	53,000	71,500	10.5	29.1	.08, .09, .08, .09, .09, .09, .09, .13, .21*, .10	Silky; opened oblique and longitudinal seams in stem in 9 places.
8334	40	.....do.....	.....	(a)	63,400	3.1	6.7	.08*, .02, .02, .04, .03, .03, .03, .02, .02, .02	Coarse granular, flaky. Ruptured at an oblique seam in stem.
8335	41	.....do.....	.....	(a)	69,800	6.4	11.8	.06, .05, .13*, .07, .05, .06, .06, .06, .05, .05	Coarse granular, flaky.
8336	42	Longitudinal specimen...	.....	(a)	56,200	1.1	1.5	.01, .01, 0, .01, .01, .01, .01, .01, .01, .03*	Do.
8337	43	.....do.....	Annealed.	47,000	59,600	5.1	15.1	.21*, .02, .03, .04, .04, .03, .03, .04, .04, .03	Silky; blue-black, amorphous spot. Opened 7 cracks in stem.
8338	44	.....do.....	.....	(a)	66,400	3.1	5.0	.04, .04, .02, .03, .03, .03, .03. .03, .03, .03	Coarse granular, 85 per cent; smooth lustrous, 15 per cent. Opened cracks in stem.
8339	45	.....do.....	.....	(a)	37,100	(b)	(b)	.....	Coarse granular, 70 per cent; blue-black, amorphous, 30 per cent.
8340	46	.....do.....	.....	(a)	30,300	(b)	(b)	.....	Coarse granular, 50 per cent; dark brown, amorphous, 50 per cent.
8341	47	.....do.....	Annealed.	(a)	51,000	2.4	10.1	.02, .02, .06*, .05, .02, .01, .02, .01, .02, .01	Coarse granular, 60 per cent; smooth lustrous, 40 per cent.
8342	48	.....do.....	.....	(a)	59,800	2.4	3.2	.02, .03, .05*, .02, .03, .02, .02, .01, .02, .02	Coarse granular. Opened cracks in stem.
8343	49	.....do.....	.....	(a)	40,000	(b)	(b)	.....	Coarse granular, 60 per cent; smooth lustrous, 40 per cent.
8344	50	Transverse specimen.....	.....	(a)	63,900	3.6	5.0	.03, .02, .03, .03, .03, .10*, .04, .03, .02, .03	Coarse granular, 90 per cent; seamy, oblique, 10 per cent.
8345	51	.....do.....	Annealed.	(a)	68,000	8.4	24.6	.08, .19*, .09, .07, .07, .08, .07, .06, .08, .05	Silky, with light, silvery, lustrous spot.
8346	52	.....do.....	.....	(a)	66,800	4.1	5.0	.03, .05, .03, .03, .10*, .03, .05, .03, .03, .03	Coarse granular; dark colored, seamy spot. Opened cracks in stem.
8347	53	.....do.....	Annealed.	48,000	71,000	10.0	24.6	.09, .09, .08, .13, .19*, .09, .09, .08, .07, .09	Silky. Opened cracks in stem.
8348	54	.....do.....	.....	(a)	48,200	1.0	3.2	.....	Coarse granular, in part smooth, lustrous, oblique.

8349	55	Longitudinal specimen...	.....	(a)	76,000	17.1	33.5	.10, .17, .32*, .32*, .16, .13, .15, .14, .11, .11	Silky, interspersed with granular metal.
8350	56	.....do.....	.....	(a)	53,800	0.7	(b)	.....	Coarse granular, flaky.
8351	57	.....do.....	Annealed.	(a)	47,700	1.4	8.4	.....	Silky, 70 per cent; blue-black, amorphous, 30 per cent.
8352	58	.....do.....	.....	(a)	69,900	5.7	8.4	.05, .05, .06, .07*, .07, .05, .05, .06, .05, .06	Coarse granular; oblique seamy spot.
8353	59	.....do.....	.....	(a)	74,800	18.1	33.5	.10, .13, .34*, .25*, .18, .20, .20, .16, .13, .12	Silky, interspersed with granular metal.
8354	60	.....do.....	.....	(a)	74,100	14.1	24.6	.10, .14, .16, .30*, .16, .16, .13, .11, .08, .07	Granular; seamy spot.
8355	61	.....do.....	Annealed.	48,000	68,000	9.3	18.3	.08, .08, .08, .08, .09, .08, .11, .18*, .08, .07	Silky. Opened cracks in stem.
8356	62	.....do.....	.....	(a)	68,000	6.8	13.4	.06, .07, .06, .07, .06, .06, .05, .06, .05, .14*	Coarse granular, 85 per cent; smooth, lustrous, oblique 15 per cent.
8357	63	.....do.....	.....	(a)	70,900	8.4	11.8	.12*, .09, .09, .10, .08, .07, .07, .08, .07, .07	Coarse granular; seamy spot.
8358	64	Longitudinal specimen from edge of slice.	Annealed.	48,000	68,000	10.5	24.6	.08, .09, .09, .10, .22*, .12, .10, .10, .08, .07	Silky. Fractured at group of blowholes.
8359	65	.....do.....	.....	(a)	69,600	7.6	13.4	.07, .04, .08, .07, .09, .11*, .10, .06, .08, .06	Granular. Blowholes.
8360	66	.....do.....	.....	(a)	43,900	1.3	3.2	.....	Granular, 45 per cent; spongy, 55 per cent.

[a] Indefinite.

[b] Inappreciable.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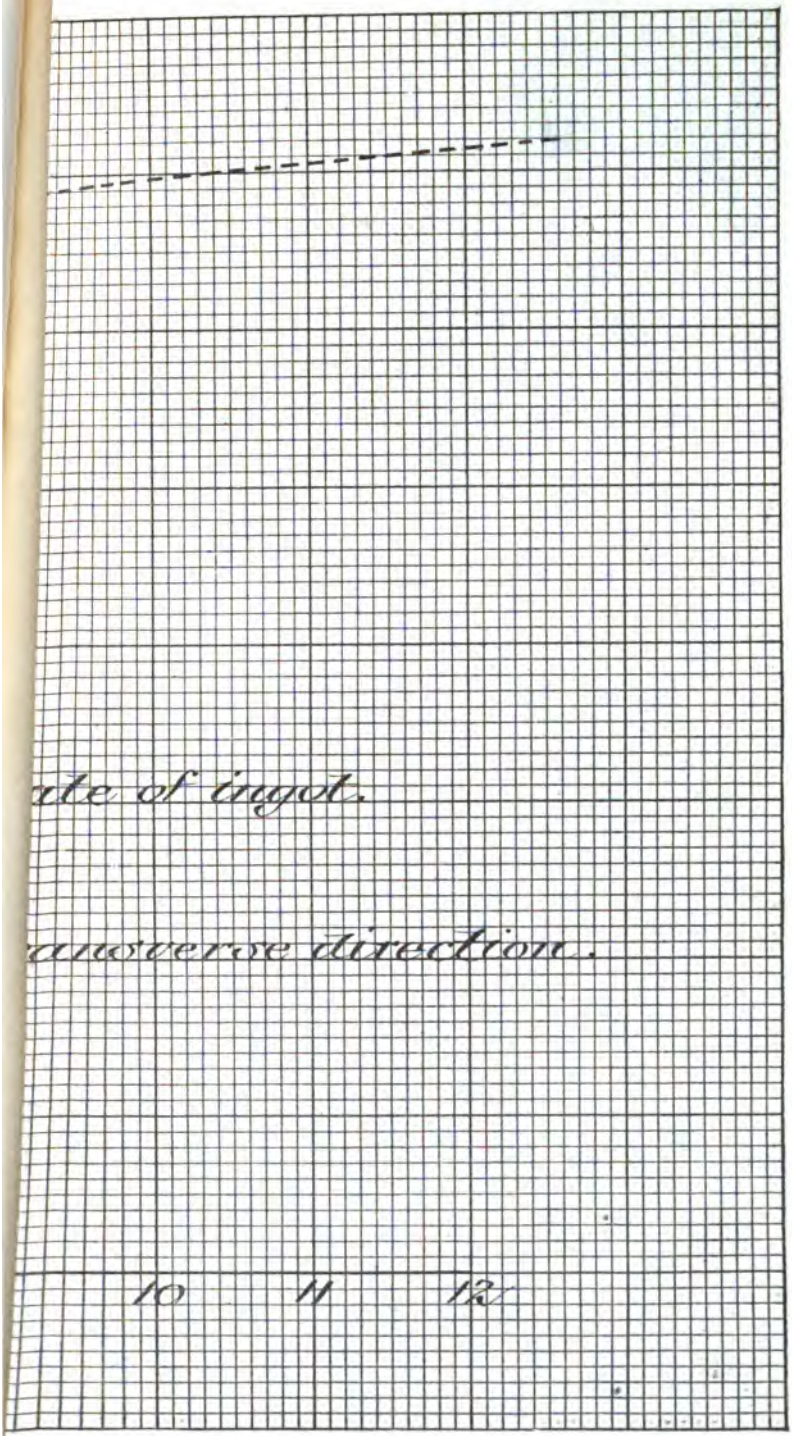
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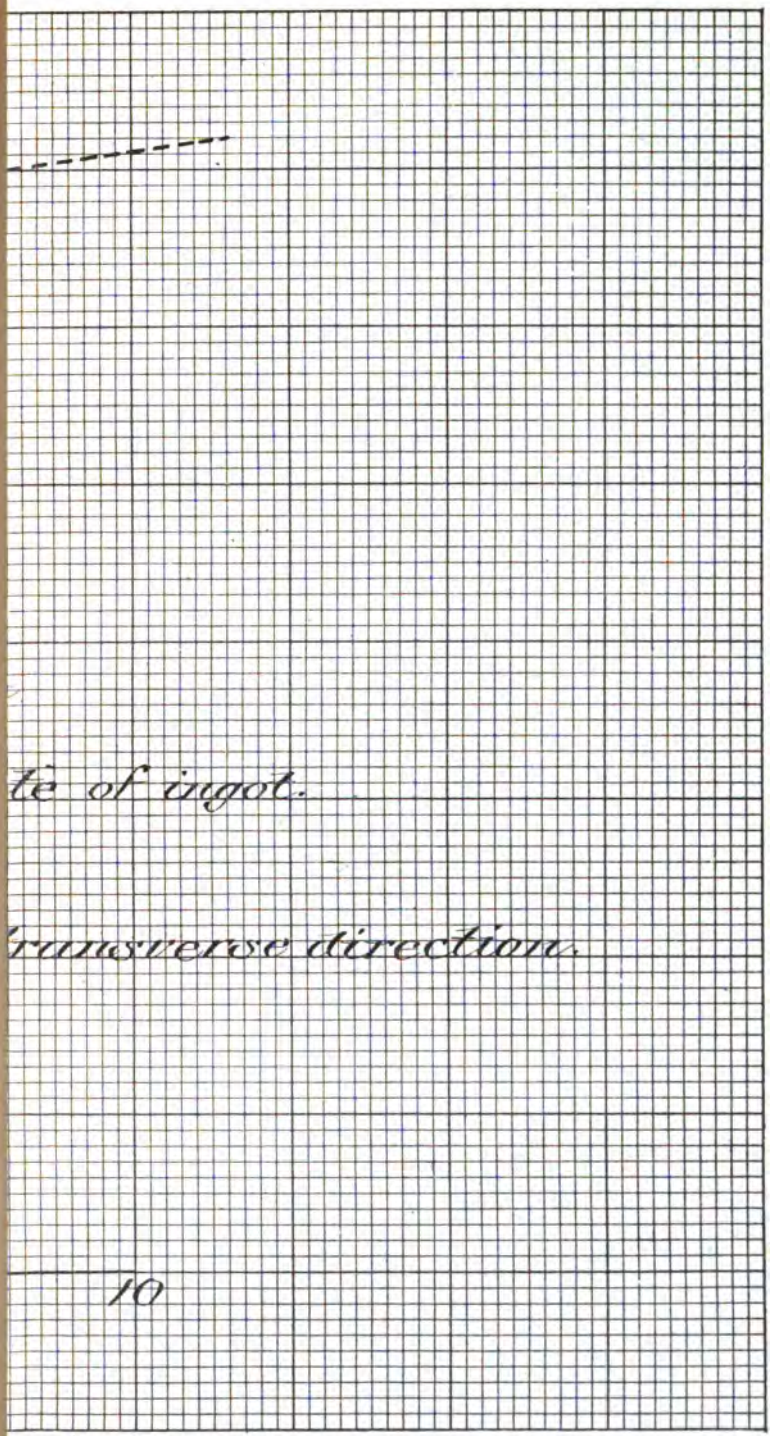
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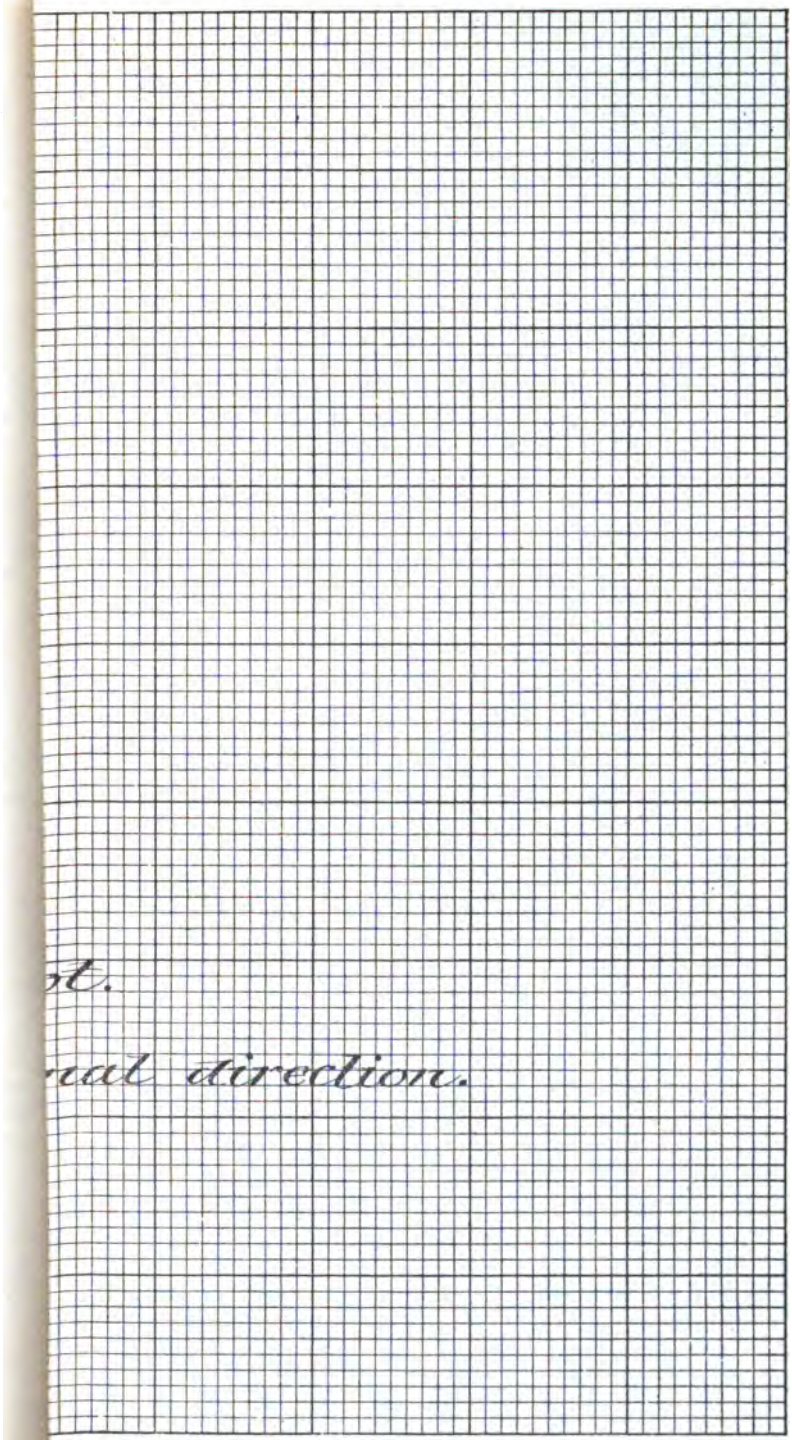
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ENDURANCE OF ROTATING SHAFTS.

No. 388.

Marks, .82 C.
Gautier steel bar; 0.82 per cent carbon. Hot-rolled bar.
Diameter, 1″. Speed of rotation, 500 per minute.
Length between end supports, 33″.
Loaded over 4″ length at middle.
Deflections measured on chord of 10″.

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
40,000	.....	58,140,720	.....	.....	.....	.....	.....	.....	Reported in 1904.
40,000	45,062,670	103,203,390	.....	.....	.....	.....	.....	.....	Reported in 1905.
40,000	49,425,810	152,629,200	.....	.....	.....	.....	.....	.....	Rested 20 days without load.
40,000	7,383,130	160,012,330	.....	.....	.....	.....	.....	.....	Bar not ruptured. Still running.

No. 405.

Marks, 1.09 C.
Gautier steel bar; 1.09 per cent carbon. Hot-rolled bar.
Diameter, 1″. Speed of rotation, 500 per minute.
Length between end supports, 33″.
Loaded over 4″ length at middle.
Deflections measured on chord of 10″.

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
35,000	.....	12,876,430	.....	.....	.....	.....	.....	.....	Reported in 1905.
35,000	49,963,310	62,839,740	.....	.....	.....	.....	.....	.....	Rested 20 days without load.
35,000	7,460,980	70,300,720	.....	.....	.....	.....	.....	.....	Bar not ruptured. Still running.

No. 406.

Marks, .17 C An.
Annealed series.
Gautier steel bar; 0.17 per cent carbon. Hot-rolled bar.
Diameter, 1″. Speed of rotation, 500 per minute.
Length between end supports, 33″.
Loaded over 4″ length at middle.
Deflections measured on chord of 10″.

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
40,000	0	0	a	.1562	.1245	.1560	.0315	.0002	
			b	.1563	.1240	.1558	.0318	.0005	
40,000	100	100	a	.1560	.1232	.1554	.0322	.0006	
			b	.1570	.1230	.1553	.0323	.0017	
40,000	900	1,000	a	.1604	.1192	.1510	.0318	.0094	
			b	.1605	.1165	.1495	.0330	.0110	
40,000	9,000	10,000	a	.1672	.1280	.1598	.0318	.0074	Bar run hot.
			b	.1523	.1139	.1470	.0331	.0053	
40,000	175,780	185,780							Bar ruptured 1″.10 north of the north edge of south middle bearing, or between middle bearings.

No. 407.

Marks, .17C–An.
Annealed series.
Gautier steel bar; 0.17 per cent carbon. Hot-rolled bar.
Diameter, 1″. Speed of rotation, 500 per minute.
Length between end supports, 33″.
Loaded over 4″ length at middle.
Deflections measured on chord of 10″.

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds.				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
40,000	0	0	a	.1573	.1250	.1570	.0320	.0003	
			b	.1571	.1248	.1570	.0322	.0001	
40,000	100	100	a	.1568	.1249	.1570	.0321	−.0002	
			b	.1575	.1248	.1570	.0322	.0005	
40,000	1,000	1,100	a	.1589	.1236	.1560	.0324	.0029	
			b	.1585	.1233	.1558	.0325	.0027	
40,000	10,000	11,100	a	.1491	.1157	.1487	.0330	.0004	
			b	.1657	.1220	.1550	.0330	.0107	
40,000	88,900	100,000	a	.1638	.1233	.1565	.0332	.0073	
			b	.1577	.1182	.1515	.0333	.0062	
									Bar annealed.
40,000	0	100,000	a	.1628	.1302	.1622	.0320	.0006	
			b	.1523	.1174	.1490	.0316	.0033	
40,000	100	100,100	a	.1584	.1250	.1578	.0328	.0006	
			b	.1565	.1135	.1462	.0327	.0103	
40,000	1,000	101,100	a	.1649	.1202	.1532	.0330	.0117	
			b	.1598	.1080	.1411	.0331	.0187	
40,000	10,000	111,100	a	.1690	.1327	.1655	.0328	.0035	
			b	.1486	.1120	.1454	.0334	.0032	
40,000	38,900	150,000	a	.1655	.1261	.1595	.0334	.0060	
			b	.1545	.1141	.1476	.0335	.0069	
									Bar annealed.
40,000	0	150,000	a	.1524	.1185	.1512	.0327	.0012	
			b	.1620	.1232	.1545	.0313	.0075	
40,000	100	150,100	a	.1505	.1170	.1502	.0332	.0003	
			b	.1634	.1195	.1518	.0323	.0116	
40,000	1,000	151,100	a	.1703	.1170	.1505	.0335	.0198	
			b	.1635	.1133	.1462	.0329	.0173	
40,000	10,000	161,100	a	.1655	.1286	.1612	.0326	.0043	
			b	.1518	.1152	.1483	.0331	.0035	
40,000	38,900	200,000	a	.1702	.1279	.1605	.0326	.0097	
			b	.1730	.1172	.1498	.0326	.0032	
									Bar annealed.
40,000	0	200,000	a	.1440	.1065	.1383	.0318	.0057	
			b	.1740	.1360	.1678	.0318	.0062	
40,000	100	200,100	a	.1482	.1064	.1390	.0326	.0092	
			b	.1732	.1330	.1653	.0323	.0079	
40,000	1,000	201,100	a	.1467	.1041	.1370	.0329	.0097	
			b	.1745	.1280	.1605	.0325	.0140	
40,000	5,600	206,700							Bar ruptured at center of north middle bearing.

No. 408.

Marks, .17C–An.
Annealed series.
Gautier steel bar; 0.17 per cent carbon. Hot-rolled bar.
Diameter, 1″. Speed of rotation, 500 per minute.
Length between end supports, 33″.
Loaded over 4″ length at middle.
Deflections measured on chord of 10″.

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.					Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.				
Pounds.				*Inch.*	*Inch.*	*Inch.*		*Inch.*	*Inch.*	
40,000	0	0	a	.1557	.1235	.1554		.0319	.0003	
			b	.1559	.1234	.1555		.0321	.0004	
40,000	100	100	a	.1555	.1234	.1555		.0321	0.	
			b	.1559	.1230	.1555		.0325	.0004	
40,000	1,000	1,100	a	.1550	.1231	.1550		.0319	0.	
			b	.1564	.1231	.1552		.0321	.0012	
40,000	10,000	11,100	a	.1552	.1195	.1518		.0323	.0034	
			b	.1591	.1194	.1523		.0329	.0068	
40,000	88,900	100,000	a	.1614	.1235	.1562		.0327	.0052	
			b	.1549	.1175	.1505		.0330	.0044	
										Bar annealed.
40,000	0	100,000	a	.1585	.1224	.1549		.0325	.0036	
			b	.1555	.1165	.1438		.0273	.0117	
40,000	100	100,100	a	.1547	.1221	.1540		.0319	.0007	
			b	.1563	.1157	.1482		.0325	.0081	
40,000	1,000	101,100	a	.1549	.1170	.1500		.0330	.0049	
			b	.1592	.1115	.1445		.0330	.0147	
40,000	10,000	111,100	a	.1605	.1244	.1562		.0318	.0043	
			b	.1532	.1162	.1490		.0328	.0042	
40,000	39,900	151,000	a	.1520	.1181	.1512		.0331	.0008	Bar run hot.
			b	.1590	.1185	.1512		.0327	.0078	
										Bar annealed.
40,000	0	151,000	a	.1541	.1211	.1533		.0322	.0008	
			b	.1550	.1180	.1500		.0320	.0050	
40,000	100	151,100	a	.1550	.1182	.1508		.0326	.0042	
			b	.1578	.1132	.1458		.0326	.0120	
40,000	1,000	152,100	a	.1470	.1114	.1443		.0329	.0027	
			b	.1627	.1074	.1408		.0334	.0219	
40,000	10,000	162,100	a	.1513	.1180	.1510		.0330	.0003	
			b	.1573	.1209	.1533		.0324	.0040	
40,000	38,900	201,000	a	.1580	.1235	.1563		.0328	.0017	
			b	.1524	.1170	.1500		.0330	.0024	
										Bar annealed.
40,000	0	201,000	a	.1528	.1190	.1518		.0328	.0010	
			b	.1570	.1207	.1527		.0320	.0043	
40,000	100	201,100	a	.1445	.1095	.1425		.0330	.0020	
			b	.1660	.1123	.1455		.0332	.0205	
40,000	1,000	202,100	a	.1425	.1070	.1408		.0338	.0017	
			b	.1658	.1059	.1400		.0341	.0258	
40,000	2,330	204,430								Bar ruptured .60 south of south edge of north middle bearing.

No. 409.

Marks, .17 C–An.
Annealed series.
Gautier steel bar; 0.17 per cent carbon. Hot-rolled bar.
Diameter, 1″. Speed of rotation, 500 per minute.
Length between end supports, 33″.
Loaded over 4″ length at middle.
Deflections measured on chord of 10″.

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
40,000	0	0	a	.1560	.1238	.1559	.0321	.0001	
			b	.1564	.1250	.1560	.0310	.0004	
40,000	100	100	a	.1552	.1227	.1552	.0325	0.	
			b	.1568	.1237	.1554	.0317	.0014	
40,000	1,000	1,100	a	.1638	.1170	.1502	.0332	.0136	
			b	.1623	.1164	.1496	.0332	.0127	
40,000	10,000	11,100	a	.1665	.1280	.1600	.0320	.0065	
			b	.1522	.1146	.1475	.0329	.0047	
40,000	211,670	222,770							Bar ruptured 1″.60 north of north edge of south middle bearing, or between middle bearings.

No. 410.

Marks, .17 C–An.
Annealed series.
Gautier steel bar; 0.17 per cent carbon. Hot-rolled bar.
Diameter, 1″. Speed of rotation, 500 per minute.
Length between end supports, 33″.
Loaded over 4″ length at middle.
Deflections measured on chord of 10″.

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
40,000	0	0	a	.1562	.1238	.1560	.0322	.0002	
			b	.1565	.1235	.1560	.0325	.0005	
40,000	100	100	a	.1560	.1228	.1555	.0327	.0005	
			b	.1570	.1230	.1556	.0326	.0014	
40,000	1,000	1,100	a	.1624	.1163	.1495	.0332	.0129	
			b	.1635	.1155	.1489	.0334	.0146	
40,000	10,000	11,100	a	.1475	.1148	.1475	.0327	0.	
			b	.1655	.1298	.1610	.0312	.0045	
40,000	38,900	50,000	a	.1507	.1173	.1505	.0332	.0002	Bar run hot.
			b	.1623	.1201	.1530	.0329	.0093	
									Bar annealed.
40,000	0	50,000	a	.1564	.1240	.1562	.0322	.0002	
			b	.1571	.1245	.1564	.0319	.0007	
40,000	100	50,100	a	.1560	.1227	.1555	.0328	.0005	
			b	.1580	.1231	.1555	.0324	.0025	
40,000	1,000	51,100	a	.1665	.1176	.1509	.0333	.0156	
			b	.1628	.1152	.1485	.0333	.0143	
40,000	10,000	61,100	a	.1074	.1290	.1615	.0325	.0059	Bar hot.
			b	.1500	.1131	.1462	.0331	.0038	
40,000	38,900	100,000	a	.1659	.1277	.1603	.0326	.0056	
			b	.1516	.1148	.1480	.0332	.0036	
									Bar annealed.
40,000	0	100,000	a	.1576	.1257	.1572	.0315	.0004	
			b	.1527	.1204	.1519	.0315	.0008	
40,000	100	100,100	a	.1594	.1217	.1541	.0324	.0053	
			b	.1550	.1180	.1494	.0314	.0056	
40,000	1,000	101,100	a	.1503	.1111	.1439	.0328	.0064	
			b	.1651	.1094	.1424	.0330	.0227	
40,000	10,000	111,100	a	.1537	.1198	.1526	.0328	.0011	Bar hot.
			b	.1550	.1202	.1528	.0326	.0022	
40,000	14,410	125,510	.....	.....	.....	.....	.....	.....	Bar ruptured 1″.40 north of north edge of south middle bearing.

No. 411.

Marks, T.–65.
Railroad rail head.
Diameter, 1″. Speed of rotation, 500 per minute.
Length between end supports, 33″.
Loaded over 4″ length at middle.
Deflections measured on chord of 10″.

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
40,000	0	0	a	.1560	.1220	.1550	.0330	.0010	
			b	.1563	.1230	.1557	.0327	.0006	
40,000	100	100	a	.1557	.1225	.1557	.0332	0.	
			b	.1561	.1230	.1556	.0326	.0005	
40,000	1,000	1,100	a	.1560	.1221	.1559	.0338	.0001	
			b	.1560	.1230	.1560	.0330	0.	
40,000	10,000	11,100	a	.1558	.1220	.1558	.0338	0.	
			b	.1561	.1225	.1560	.0335	.0001	
40,000	50,226,480	50,237,580							Bar rested 20 days without load.
40,000	7,687,880	57,925,460							Bar not ruptured. Still running.

No. 412.

Marks, .34C.
Gautier steel bar; 0.34 per cent carbon. Hot-rolled bar.
Diameter, 1″. Speed of rotation, 500 per minute.
Length between end supports, 33″.
Loaded over 4″ length at middle.
Deflections measured on chord of 10″.

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds.				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
40,000	0	0	a	.1568	.1243	.1566	.0323	.0002	
			b	.1567	.1243	.1566	.0323	.0001	
40,000	100	100	a	.1568	.1245	.1567	.0322	.0001	
			b	.1567	.1245	.1565	.0320	.0002	
40,000	1,000	1,100	a	.1566	.1244	.1565	.0321	.0001	
			b	.1569	.1240	.1566	.0326	.0003	
40,000	10,000	11,100	a	.1565	.1241	.1563	.0322	.0002	
			b	.1570	.1230	.1563	.0327	.0007	
40,000	88,900	100,000	a	.1573	.1237	.1562	.0325	.0011	
			b	.1571	.1230	.1560	.0330	.0011	
40,000	27,354,580	27,454,580							Bar rested without load 20 days.
40,000	7,606,920	35,061,500							Bar not ruptured. Still running.

ENDURANCE OF ROTATING SHAFTS.

SUMMARIZED TABULATION.

Speed of rotation, 500 per minute.

No. of test.	Marks.	Material.	Treatment.	Composition.				Maximum fiber stress per square inch.	Number of rotations.		Remarks.
				C.	Mn.	Si.	Ni.		Successive.	Total.	
								Pounds.			
388	.82C	Gautier steel	Hot-rolled bar	.82	.36	.10	.....	40,000	.....	160,012,330	Bar not ruptured.
405	1.09C	....do	....do	1.09	.39	.11	.....	35,000	.....	70,300,720	Do.
406	.17C-An	....do	....do	.17	.57	.04	.....	40,000	.....	185,780	Ruptured between bearings.
407	.17C-An	....do	Hot-rolled bar. Annealed during test.	.17	.57	.04	.....	40,000	.....	206,700	Ruptured at center of north middle bearing.
408	.17C-An	....do	....do	.17	.57	.04	.....	40,000	.....	204,430	Ruptured between bearings.
409	.17C-An	...do	Hot-rolled bar	.17	.57	.04	.....	40,000	.....	222,770	Do.
410	.17C-An	....do	Hot-rolled bar. Annealed during test.	.17	.57	.04	.....	40,000	.....	125,510	Do.
411	T-65	Railroad rail head						40,000	.....	57,925,460	Bar not ruptured.
412	.34C	Gautier steel	Hot-rolled bar	.34	.65	.34	.....	40,000	.....	35,061,500	Do.

TENSILE SPECIMENS

FROM RUPTURED ENDURANCE SHAFTS.

TENSION TESTS OF SPECIMENS FROM RUPTURED ENDURANCE SHAFTS.

Taken from outer ends.

No. 8257.

Marks, .82C–385.
Diameter, ″.564.
Sectional area, .25 square inch.
Gauged length, 3″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0009	.....	
20,000	.0020	.....	
30,000	.0030	0.	
40,000	.0040	.....	
50,000	.0050	.....	
60,000	.0060	0.	
64,000	.0066	.....	Elastic limit.
66,000	.0078	.....	
68,000	.0138	.....	
70,000	.0155	.0075	
72,000	.0176	.....	
74,000	.0196	.....	
76,000	.0223	.....	
80,000	.0270	.....	
84,000	.0318	.....	
88,000	.0380	.....	
92,000	.0425	.....	
96,000	.0485	.....	
100,000	.0545	.0402	
108,000	.07	.....	
116,000	.09	.....	
124,000	.11	.....	
132,000	.13	.....	
140,000	.20	.....	
142,800	.....	.....	Tensile strength.
0	.22	.....	= 7.3 per cent.

Elongation of inch sections, ″.06, ″.09*, ″.07*.
Diameter at fracture, ″.53; area, .2206 square inch.
Contraction of area, 11.8 per cent.
Position of fracture, 1″.11 from the neck.
Appearance of fracture, fine granular. Fractured at center-punch mark defining inch sections.

No. 8258.

Marks, .17C–An–406.
Diameter, ″.564.
Sectional area, .25 square inch.
Gauged length, 3″.
Metal of endurance shaft was annealed.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0009	.....	
20,000	.0019	.....	
30,000	.0029	0.	
35,000	.0034	.....	
39,000	.0038	.....	Elastic limit.
40,000	.0055	.....	Load fell.
36,000	.0070	.....	
37,000	.0088	.....	
38,000	.0205	.....	
40,000	.0560	.....	
42,000	.0653	.....	
44,000	.0755	.....	
48,000	.11	.....	
52,000	.14	.....	
56,000	.18	.....	
60,000	.25	.....	
64,000	.37	.....	
66,320	.....	.....	Tensile strength.
0	.90	.....	= 30 per cent.

Elongation of inch sections, ″.20, ″.48*, ″.22.
Diameter at fracture, ″.38; area, .1134 square inch.
Contraction of area, 54.6 per cent.
Position of fracture, 1″.7 from the neck.
Appearance of fracture, fine silky.

No. 8259.

Marks, .17C–An–407.
Diameter, ″.564.
Sectional area, .25 square inch.
Gauged length, 3″.
Metal of endurance shaft was annealed.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0009	.....	
30,000	.0029	0.	
35,000	.0035	.....	
40,000	.0039	.....	
41,000	.0040	.....	
42,000	.0042	.....	Elastic limit. Load fell.
36,000	.0081	.....	
37,000	.0104	.....	
38,000	.0147	.....	
40,000	.0585	.....	
44,000	.07	.....	
48,000	.10	.....	
52,000	.13	.....	
56,000	.17	.....	
60,000	.23	.....	
64,000	.36	.....	
66,400	.....	.....	Tensile strength.
0	.94	.....	=31.3 per cent.

Elongation of inch sections, ″.23, ″.50*, ″.21.
Diameter at fracture, ″.38; area, .1134 square inch.
Contraction of area, 54.6 per cent.
Position of fracture, at middle of stem.
Appearance of fracture, fine silky.

No. 8260.

Marks, .17C–An–408.
Diameter, ″.564.
Sectional area, .25 square inch.
Gauged length, 3″.
Metal of endurance shaft was annealed.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0009	.....	
30,000	.0030	0.	
35,000	.0035	.....	
40,000	.0040	.....	Elastic limit. Load fell.
36,000	.0066	.....	
37,000	.0091	.....	
38,000	.0116	.....	
39,000	.0545	.....	
40,000	.0590	.....	
44,000	.08	.....	
48,000	.10	.....	
52,000	.14	.....	
56,000	.18	.....	
60,000	.25	.....	
64,000	.39	.....	
65,600	.....	.....	Tensile strength.
0	.80	.....	=26.7 per cent.

Elongations of inch sections, ″.15, ″.18, ″.47*.
Diameter at fracture, ″.38; area, .1134 square inch.
Contraction of area, 54.6 per cent.
Position of fracture, ″.9 from the neck.
Appearacne of fracture, fine silky.

No. 8261.

Marks, .17C–An–409.
Diameter, ″.564.
Sectional area, .25 square inch.
Gauged length, 3″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0009	.....	
30,000	.0030	0.	
35,000	.0035	.....	
40,000	.0041	0.	
44,000	.0045	.....	Elastic limit. Load fell.
41,000	.0076	.....	
42,000	.0085	.....	
43,000	.0114	.....	
44,000	.0680	.....	
48,000	.09	.....	
52,000	.12	.....	
56,000	.15	.....	
60,000	.20	.....	
64,000	.29	.....	
68,000	.50	.....	Tensile strength.
0	.90	.....	= 30 per cent.

Elongation of inch sections, ″.17, ″.44*, ″.29.
Diameter at fracture, ″.37; area, .107 square inch.
Contraction of area, 57 per cent.
Position of fracture, 1″.57 from the neck.
Appearance of fracture, fine silky.

No. 8262.

Marks, .17C–An–410.
Diameter, ″.564.
Sectional area, .25 square inch.
Gauged length, 3″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....	
30,000	.0031	.0001	
35,000	.0036	.....	
38,000	.0039	.....	Elastic limit. Load fell.
33,000	.0089	.....	
34,000	.0128	.....	
35,000	.0390	.....	
36,000	.0415	.....	
38,000	.0485	.....	
40,000	.0595	.....	
44,000	.08	.....	
48,000	.11	.....	
52,000	.14	.....	
56,000	.19	.....	
60,000	.25	.....	
64,000	.41	.....	
65,600	.....	.....	Tensile strength.
0	.94	.....	= 31.3 per cent.

Elongation of inch sections, ″.21, ″.50*, ″.23.
Diameter at fracture, ″.38; area, .1134 square inch.
Contraction of area, 54.6 per cent.
Position of fracture, 1″.87 from the neck.
Appearance of fracture, fine silky.

No. 8293.

Endurance shaft No. 301.
Marks, 7 B17 Y 1–1.
Diameter, ″.564.
Sectional area, .25 square inch.
Gauged length, 3″.
Annealed in arsenal smith shop.
For earlier test of this shaft see Report 1902, page 298.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0005	0.	
10,000	.0008	.....	
30,000	.0027	0.	
40,000	.0039	.....	
50,000	.0050	.....	
60,000	.0060	0.	
70,000	.0071	.....	
75,000	.0077	.....	
80,000	.0084	0.	
90,000	.0096	.0003	
93,000	.0104	.....	Elastic limit.
94,000	.....	.....	Load fell.
89,000	.0130	.....	
90,000	.0142	.....	
91,000	.0200	.....	
92,000	.0332	.....	
95,000	.0435	.....	
100,000	.0546	.....	
105,000	.0695	.....	
110,000	.0903	.....	
132,400	.....	.....	Tensile strength.
0	.44	.....	=14.7 per cent elongation.

Elongation of inch sections, ″.08, ″.22*, ″.14.
Diameter at fracture, ″.47; area, .1735 square inch.
Contraction of area, 30.6 per cent.
Fractured, 1″.38 from the neck.
Appearance of fracture, fine granular, gray.

No. 8294.

Endurance shaft No. 301.
Marks, 7 B17 Y 1–1.
Diameter, ″.564.
Sectional area, .25 square inch.
Gauged length, 3″.
Annealed in arsenal smith shop.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0007	.....	
30,000	.0029	.....	
40,000	.0039	.....	
50,000	.0050	.....	
60,000	.0063	.0003	
70,000	.0082	.0011	
75,000	.0092	.....	
80,000	.0106	.0023	
81,000	.0112	.....	
82,000	.0115	.....	
83,000	.0118	.....	
84,000	.0121	.....	
85,000	.0124	.....	
86,000	.0127	.....	
87,000	.0133	.....	
88,000	.0136	.....	
89,000	.0141	.....	
90,000	.0146	.0051	
91,000	.0156	.....	
92,000	.0159	.....	
93,000	.0165	.....	
94,000	.0172	.....	
95,000	.0178	.....	
100,000	.0226	.....	
105,000	.0282	.....	
110,000	.0371	.....	
145,600	.....	.....	Tensile strength.
0	.24	.....	=8 per cent elongation.

Elongation of inch sections, ″.08, ″.09*, ″.07.
Diameter at fracture, ″.53; area, .2206 square inch.
Contraction of area, 11.8 per cent.
Fractured 1″.2 from the neck.
Appearance of fracture, fine granular.
Elastic limit not well defined.

TABULATION OF TENSION SPECIMENS FROM OUTER ENDS OF BARS RUPTURED BY ENDURANCE TESTS OF ROTATING SHAFTS.

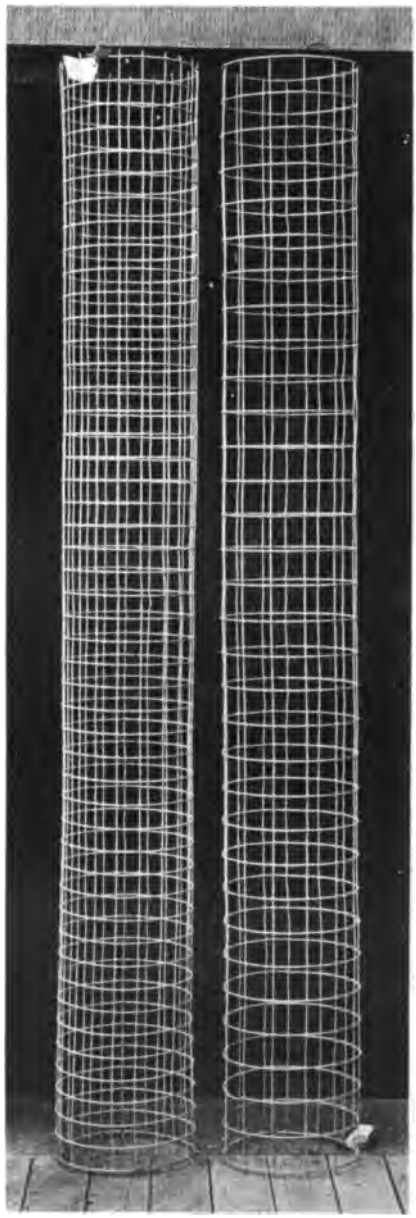
Gauged length, 3″.

Tension test number.	Endurance test number.	Description.	Carbon.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation in 3 inches.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
				Sq. inch.	*Pounds.*	*Pounds.*	*Per cent.*	*Per cent.*	″ ″ ″	
8257	385	Hot-rolled bar; annealed	.82	.25	64,000	142,800	7.3	11.8	.06,.09*,.07*	Fine granular.
8258	406	Annealed	.17	.25	39,000	66,320	30.0	54.6	.20,.48*,.22	Fine silky.
8259	407	do	.17	.25	42,000	66,400	31.3	54.6	.23,.50*,.21	Do.
8260	408	do	.17	.25	40,000	65,600	26.7	54.6	.15,.18,.47*	Do.
8261	409	do	.17	.25	44,000	68,000	30.0	57.0	.17,.44*,.29	Do.
8262	410	do	.17	.25	38,000	65,600	31.3	54.6	.21,.50*,.23	Do.
8293	301	do	.32	.25	93,000	132,400	14.7	30.6	.08,.22*,.14	Fine granular, gray.
8294	301	do	.32	.25	(a)	145,600	8.0	11.8	.08,.09*,.07	Fine granular.

a Elastic limit not well defined.

CONCRETE AND MORTAR COLUMNS.

PLAIN AND REËNFORCED WITH STEEL WIRE CAGES, HOOPS (WITH AND WITHOUT LONGITUDINAL ANGLE BARS), AND KAHN AND TRUSCON BARS (WITH AND WITHOUT HOOPS).



WIRE CAGES, AND HOOPS AND ANGLES USED FOR REINFORCEMENT OF MORTAR AND CONCRETE COLUMNS

CONCRETE COLUMN, 1 : 2 : 4 MIXTURE.

SPOTTED APPEARANCE, WHEN THREE DAYS OLD, ATTRIBUTED TO IRREGULAR DISTRIBUTION OF STONE AGGREGATE; EARLY DRYING OF MORTAR OVER THE STONE.

CAMPBELL ART CO.
ELIZABETH, N. J.

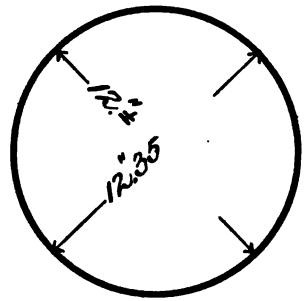
CONCRETE COLUMNS, PLAIN AND REINFORCED, SHOWING ARRANGEMENT OF SIDE-RODS AND END PLATES FOR SUBJECTING COLUMNS TO LONG CONTINUED LOADS.

CAMPBELL ART CO.
ELIZABETH, N. J.

No. 1718.

1 : 2 : 4 Mixture.

Reënforced with steel wire cage, 2″×2″ meshes; 49 circular wires ″.104 diameter each, electrically welded ends; 19 longitudinal wires ″.104 diameter each; intersections electrically welded.



Composition, by volume: Alpha cement, 1; sand, 2; trap rock (¼″ to 1½″), 4. Water, 64.3 per cent of cement, by weight.

Age, set in air, 5 months 8 days.

Weight of column, total, 1,007 pounds.

Weight of concrete, 999 pounds = 149.8 pounds per cubic foot.

Weight of wire cage, 8 pounds.

Height of column, 96.40 inches.

Diameter of column, 12.35 inches.

Sectional area, gross, 119.79 square inches.

Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
11,979	100	0.	0.	Initial load. Loaded with 10,000 pounds before testing.
17,969	150	.0004	0.	
23,958	200	.0009	0.	
29,948	250	.0014	.0001	
35,937	300	.0020	.0003	
41,927	350	.0025	.0003	
47,916	400	.0033	.0003	
53,906	450	.0041	.0004	
59,895	500	.0048	.0005	
65,885	550	.0055	.0006	
71,874	600	.0064	.0008	E (100–600) = 4,464,000 pounds per square inch.
.....	600	.0066	.0009	
77,864	650	.0073	.0010	
83,853	700	.0081	.0011	
89,843	750	.0089	.0012	
95,832	800	.0098	.0014	
101,822	850	.0108	.0015	
107,811	900	.0118	.0018	
113,801	950	.0125	.0020	
119,790	1,000	.0137	.0022	E (600–1,000) = 3,390,000 pounds per square inch.
.....	600	.0084	.0022	
.....	600	.0084	.0023	
131,769	1,100	.0156	.0027	
143,748	1,200	.0179	.0035	
155,727	1,300	.0202	.0041	
167,706	1,400	.0229	.0054	
179,685	1,500	.0260	.0059	E (1,000–1,500) = 2,907,000 pounds per square inch.

No. 1718—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
.....	600	.0131	.0060	
.....	600	.0130	.0060	
191,664	1,600	.0286	.0068	
203,643	1,700	.0322	.0083	
215,622	1,800	.0371	.0105	
227,601	1,900	.0422	.0130	
239,580	2,000	.0477	.0158	E (1,500-2,000)=2,119,000 pounds per square inch. Minute crack near lower end of column.
.....	600	.0250	.0156	
.....	600	.0250	.0156	
251,559	2,100	.0553	.0201	
263,538	2,200	.....	.....	Ultimate strength.

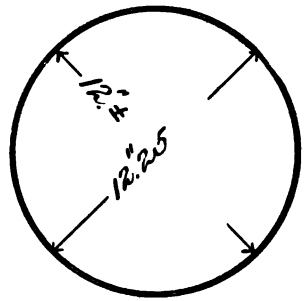
Opened longitudinal and oblique cracks in lower two feet of the column. The resistance of the column gradually diminished as the disintegration progressed. When the resistance had fallen to 160,000 pounds the total height of column was 96″.03. The test was then discontinued.

The longitudinal wires buckled in an outward, radial direction in the 2-foot section which ruptured. The immediate surface portions of the concrete were detached between the circular wires of the cage.

No. 1722.

1 : 2 : 4 Mixture.

Reënforced with steel wire cage, 3″×3″ meshes; 33 circular wires ″.104 diameter each, electrically welded ends; 13 longitudinal wires ″.104 diameter each; intersections electrically welded.



Composition, by volume: Alpha cement, 1; sand, 2; trap rock (¾″ to 1½″), 4. Water, 60.5 per cent of cement, by weight.

Age, set in air, 5 months 13 days.

Weight of column, total, 1,009 pounds.

Weight of concrete, 1,003 pounds = 151.3 pounds per cubic foot.

Weight of wire cage, 6 pounds.

Height of column, 97.40 inches.

Diameter of column, 12.25 inches.

Sectional area, gross, 117.86 square inches.

Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
11,786	100	0.	0.	Initial load. Loaded with 10,000 pounds before testing.
17,679	150	.0005	0.	
23,572	200	.0009	.0002	
29,465	250	.0016	.0003	
35,358	300	.0021	.0003	
41,251	350	.0026	.0004	
47,144	400	.0038	.0005	
53,037	450	.0044	.0006	
58,930	500	.0052	.0006	
64,823	550	.0060	.0006	
70,716	600	.0070	.0006	E (100-600) = 3,906,000 pounds per square inch.
.....	600	.0070	.0006	
76,609	650	.0079	.0008	
82,502	700	.0088	.0009	
88,395	750	.0097	.0010	
94,288	800	.0105	.0011	
100,181	850	.0116	.0013	
106,074	900	.0129	.0014	
111,967	950	.0139	.0017	
117,860	1,000	.0149	.0020	E (600-1,000) = 3,077,000 pounds per square inch.
.....	600	.0091	.0020	
.....	600	.0091	.0020	
129,646	1,100	.0169	.0023	
141,432	1,200	.0190	.0027	
153,218	1,300	.0220	.0036	
165,004	1,400	.0250	.0047	
176,790	1,500	.0276	.0055	E (1,000-1,500) = 2,717,000 pounds per square inch.

No. 1722—Continued.

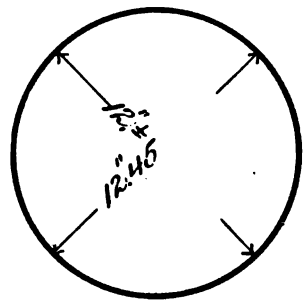
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
.....	600	.0136	.0053	
.....	600	.0136	.0053	
188,576	1,600	.0311	.0069	
200,362	1,700	.0341	.0080	
212,148	1,800	.0381	.0099	
223,934	1,900	.0446	.0132	
235,720	2,000	.0517	.0165	E (1,500-2,000)=1,908,000 pounds per square inch. Longitudinal wires buckled outward near lower end of column.
.....	600	.0274	.0164	
.....	600	.0273	.0164	
242,000	2,053	.....	.....	Ultimate strength.

Opened longitudinal and oblique cracks in lower two feet of the column. Concrete flaked off between wires of the cage. Continuing the deformation under diminished loads, one of the circular wires eventually fractured at the weld.

No. 1724.

1:2:4 Mixture.

Reënforced with steel wire cage, 3″×3″ meshes; 33 circular wires ″.145 diameter each, electrically welded ends; 13 longitudinal wires ″.104 diameter each: intersections electrically welded.



Composition, by volume: Alpha cement, 1; sand, 2; trap rock (¾″ to 1½″), 4. Water, 52.9 per cent of cement, by weight.

Age, set in air, 5 months 13 days.

Weight of column, total, 1,031 pounds.

Weight of concrete, 1,022 pounds = 149.4 pounds per cubic foot.

Weight of wire cage, 9 pounds.

Height of column, 97.30 inches.

Diameter of column, 12.45 inches.

Sectional area, gross, 121.74 square inches.

Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
12,174	100	0.	0.	Initial load. Loaded with 9,000 pounds before testing.
18,261	150	.0005	0.	
24,348	200	.0009	0.	
30,435	250	.0015	0.	
36,522	300	.0020	0.	
42,609	350	.0026	.0001	
48,696	400	.0034	.0001	
54,783	450	.0041	.0003	
60,870	500	.0049	.0004	
66,957	550	.0056	.0006	
73,044	600	.0064	.0006	E (100–600) = 4,310,000 pounds per square inch.
.....	600	.0067	.0008	
79,131	650	.0077	.0010	
85,218	700	.0083	.0010	
91,305	750	.0094	.0014	
97,392	800	.0100	.0014	
103,479	850	.0109	.0017	
109,566	900	.0119	.0018	
115,653	950	.0129	.0020	
121,740	1,000	.0137	.0021	E (600–1,000) = 3,448,000 pounds per square inch.
.....	600	.0088	.0021	
.....	600	.0087	.0021	
133,914	1,100	.0153	.0024	
146,088	1,200	.0171	.0027	Rested under initial load 16 hours.
158,262	1,300	.0179	.0029	
170,436	1,400	.0205	.0032	
182,610	1,500	.0229	.0040	E (1,000–1,500) = 3,425,000 pounds per square inch.

No. 1724—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
.....	600	.0122	.0040	
.....	600	.0122	.0040	
194,784	1,600	.0249	.0059	
206,958	1,700	.0285	.0065	
219,132	1,800	.0305	.0074	
231,306	1,900	.0336	.0089	
243,480	2,000	.0369	.0095	E (1,500-2,000)=2,941,000 pounds per square inch.
.....	600	.0175	.0098	
.....	600	.0175	.0095	
255,654	2,100	.0410	.0109	
267,828	2,200	.0450	.0128	
280,002	2,300	.0500	.0151	
292,176	2,400	.0564	.0184	
304,350	2,500	.0647	.0231	E (2,000-2,500)=1,761,000 pounds per square inch.
.....	600	.0335	.0230	
.....	600	.0338	.0224	
316,524	2,600	.0810	.0334	One longitudinal wire buckled outward.
318,000	2,610	.....	.....	Ultimate strength.

Opened longitudinal and oblique cracks along middle of its height.

NO. 1 24.

CONCRETE BEAM, 1:2:4 MIXTURE, REINFORCED WITH
STEEL WIRE CAGE, 3-INCH MESHES.

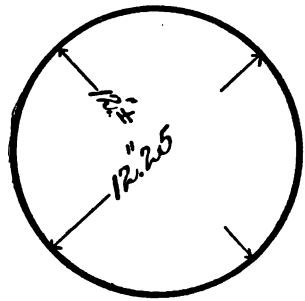
APPEARANCE OF FRACTURED SECTION AFTER COMPLETION OF TEST.

CAMPBELL ART CO.
ELIZABETH, N. J.

No. 1720.

1:3:6 Mixture.

Reënforced with steel wire cage, 2″×2″ meshes; 49 circular wires ″.104 diameter each, electrically welded ends; 19 longitudinal wires ″.104 diameter each; intersections electrically welded.



Composition, by volume: Alpha cement, 1; sand, 3; trap rock (¾″ to 1½″), 6. Water, 90.7 per cent of cement, by weight.

Age, set in air, 5 months 8 days.

Weight of column, 1,004 pounds.

Weight of concrete, 995.25 pounds = 150.1 pounds per cubic foot.

Weight of wire cage, 8.75 pounds.

Height of column, 97.50 inches.

Diameter of column, 12.25 inches.

Sectional area, gross, 117.86 square inches.

Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
11,786	100	0.	0.	Initial load. Loaded with 9,000 pounds before testing.
17,679	150	.0013	.0005	
23,572	200	.0028	.0010	
29,465	250	.0043	.0014	
35,358	300	.0060	.0020	
41,250	350	.0081	.0029	
47,144	400	.0100	.0036	
53,037	450	.0121	.0047	
58,930	500	.0143	.0054	
64,823	550	.0170	.0067	
70,716	600	.0201	.0082	E (100–600) = 2,101,000 pounds per square inch.
.....	600	.0208	.0088	
76,609	650	.0232	.0100	
82,502	700	.0266	.0117	
88,395	750	.0300	.0135	
94,288	800	.0348	.0164	
100,181	850	.0391	.0191	
106,074	900	.0445	.0222	
111,967	950	.0498	.0255	
117,860	1,000	.0566	.0302	E (600–1,000) = 1,379,000 pounds per square inch.
.....	600	.0477	.0302	
.....	600	.0475	.0303	
123,753	1,050	.0644	.0346	
129,646	1,100	.0735	.0411	Longitudinal wires in lower part of column buckle outward.

No. 1720—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
135,539	1,150	.0835	.0490	
141,432	1,200	.0940	.0549	
147,325	1,250	.1085	.0655	
153,218	1,300	.1280	.0818	
159,111	1,350	.1590	.1131	Ultimate strength.
.....	600	.1400	.1139	
.....	600	.1400	.1140	

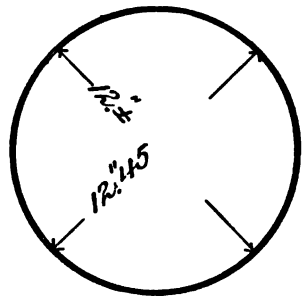
After making observations under 600 pounds per square inch the column did not again reach 1,350 pounds per square inch. Upon advancement of the load numerous longitudinal cracks, located chiefly at the middle of the height of the column, developed. The highest load now sustained was 156,000 pounds, total.

Three circular wires at middle of height of column fractured at the welds. The longitudinal wires buckled outward in various places.

No. 1719.

1 : 3 : 6 Mixture.

Reënforced with steel wire cage, 2″ ×2″ meshes; 49 circular wires ″.144 diameter each, electrically welded ends; 19 longitudinal wires ″.104 diameter each; intersections electrically welded.



Composition, by volume: Alpha cement, 1; sand, 3; trap rock (¼″ to 1½″), 6. Water, 83.2 per cent of cement, by weight.

Age, set in air, 5 months 8 days.

Weight of column, total, 1,008 pounds.

Weight of concrete, 995 pounds = 145.7 pounds per cubic foot.

Weight of wire cage, 13 pounds.

Height of column, 97.30 inches.

Diameter of column, 12.45 inches.

Sectional area, gross, 121.74 square inches.

Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
12,174	100	0.	0.	Initial load. Loaded with 10,000 pounds before testing.
18,261	150	.0020	.0004	
24,348	200	.0039	.0009	
30,435	250	.0054	.0014	
36,522	300	.0078	.0026	
42,609	350	.0100	.0035	
48,696	400	.0124	.0047	
54,783	450	.0160	.0062	
60,870	500	.0190	.0079	
66,957	550	.0220	.0098	
73,044	600	.0256	.0119	E (100–600) = 1,825,000 pounds per square inch.
.....	600	.0270	.0128	
79,131	650	.0304	.0144	
85,218	700	.0340	.0164	
91,305	750	.0390	.0196	
97,392	800	.0451	.0233	
103,479	850	.0498	.0271	
109,566	900	.0550	.0294	
115,653	950	.0618	.0341	Longitudinal wires buckled outward in places at lower end of column.
121,740	1,000	.0680	.0373	E (600–1,000) = 1,176,000 pounds per square inch. Concrete flaked off in places between circular wires of cage.
.....	600	.0580	.0380	
.....	600	.0580	.0380	

No. 1719—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
127,827	1,050	.0744	.0415	
133,914	1,100	.0798	.0451	
140,001	1,150	.0865	.0493	
146,088	1,200	.0955	.0561	
152,175	1,250	.1066	.0648	
158,262	1,300	.1185	.0736	
164,349	1,350	.1335	.0856	
.....	600	.1105	.0860	
.....	600	.1105	.0860	
168,000	1,380	.....	.....	Ultimate strength.

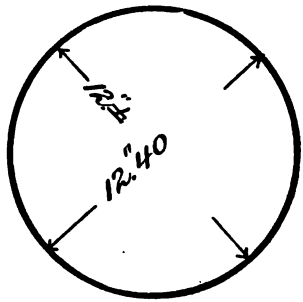
Opened cracks and concrete flaked off between the wires of the cage in the lower three feet of the column. The maximum load was sustained during the development of these cracks and until the column was shortened to a total height of 96″.90, a compression of ″.40.

Continuing the test under gradually diminishing loads, the column was shortened to 96″.72, a total compression of ″.58, which occurred when the load had fallen to 150,000 pounds. The permanent compression was chiefly confined to a section three feet long, at the lower end of the column. Three circular wires of the cage fractured at the electric butt welds.

No. 1721.

1 : 3 : 6 Mixture.

Reënforced with steel wire cage, 2″ × 2″ meshes; 49 circular wires ″.144 diameter each, electrically welded ends; 19 longitudinal wires ″.104 diameter each; intersections electrically welded.



Composition, by volume: Alpha cement, 1; sand, 3; trap rock (¼″ to 1½″), 6. Water, 90.7 per cent of cement, by weight.

Age, set in air, 5 months 8 days.

Weight of column, total, 983 pounds.

Weight of concrete, 970 pounds = 143.1 pounds per cubic foot.

Weight of wire cage, 13 pounds.

Height of column, 97.40 inches.

Diameter of column, 12.40 inches.

Sectional area, gross, 120.76 square inches.

Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
12,076	100	0.	0.	Initial load. Loaded with 10,000 pounds before testing.
18,114	150	.0011	.0003	
24,152	200	.0025	.0008	
30,190	250	.0045	.0015	
36,228	300	.0063	.0021	
42,266	350	.0080	.0028	
48,304	400	.0098	.0037	
54,342	450	.0120	.0045	
60,380	500	.0144	.0053	
66,418	550	.0164	.0064	
72,456	600	.0189	.0076	E (100-600) = 2,212,000 pounds per square inch.
.....	600	.0196	.0080	
78,494	650	.0217	.0089	
84,532	700	.0242	.0101	Rested under initial load 16 hours.
90,570	750	.0282	.0136	
96,608	800	.0322	.0151	
102,646	850	.0364	.0177	
108,684	900	.0398	.0200	
114,722	950	.0434	.0223	
120,760	1,000	.0480	.0248	E (600-1,000) = 1,680,000 pounds per square inch.
.....	600	.0395	.0251	
.....	600	.0395	.0254	
126,798	1,050	.0540	.0278	
132,836	1,100	.0600	.0313	Longitudinal wires commence to buckle.
138,874	1,150	.0643	.0344	
144,912	1,200	.0736	.0402	

No. 1721—Continued.

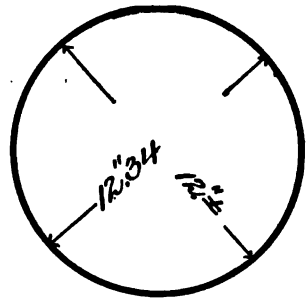
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
150,950	1,250	.0797	.0440	
156,988	1,300	.0853	.0469	
163,026	1,350	.0925	.0515	
.....	600	.0725	.0517	
.....	600	.0723	.0516	
169,064	1,400	.1030	.0590	
175,102	1,450	.1186	.0713	
181,140	1,500	.1300	.0809	E (1,000-1,500)=965,000 pounds per square inch.
.....	600	.1045	.0811	
.....	600	.1040	.0809	
183,500	1,520	.....	.....	Ultimate strength.

Opened longitudinal and oblique cracks in lower three feet of column. Concrete flaked off surface between wires of cage.

No. 1723.

1:3:6 Mixture.

Reënforced with steel wire cage, 3″ × 3″ meshes; 33 circular wires ″.104 diameter each, electrically welded ends; 13 longitudinal wires ″.104 diameter each; intersections electrically welded.



Composition, by volume: Alpha cement, 1; sand, 3; trap rock (¼″ to 1½″), 6. Water, 79.4 per cent of cement, by weight.

Age, set in air, 5 months 12 days.

Weight of column, total, 998 pounds.

Weight of concrete, 992 pounds = 147.6 pounds per cubic foot.

Weight of wire cage, 6 pounds.

Height of column, 97.20 inches.

Diameter of column, 12.34 inches.

Sectional area, gross, 119.60 square inches.

Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
11,960	100	0.	0.	Initial load. Loaded with 11,000 pounds before testing.
17,940	150	.0009	0.	
23,920	200	.0018	.0002	
29,900	250	.0030	.0005	
35,880	300	.0041	.0008	
41,860	350	.0052	.0009	
47,840	400	.0062	.0013	
53,820	450	.0075	.0015	
59,800	500	.0085	.0017	
65,780	550	.0097	.0020	
71,760	600	.0109	.0024	E (100-600) = 2,941,000 pounds per square inch.
.....	600	.0110	.0024	
77,740	650	.0123	.0028	
83,720	700	.0134	.0031	
89,700	750	.0145	.0034	
95,680	800	.0160	.0039	
101,660	850	.0177	.0046	
107,640	900	.0188	.0049	
113,620	950	.0203	.0054	
119,600	1,000	.0221	.0062	E (600-1,000) = 2,703,000 pounds per square inch.
.....	600	.0155	.0062	
.....	600	.0155	.0063	

No. 1723—Continued.

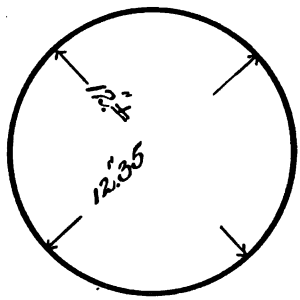
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
125,580	1,050	.0238	.0069	
131,560	1,100	.0253	.0076	
137,540	1,150	.0275	.0085	
143,520	1,200	.0294	.0092	
149,500	1,250	.0314	.0100	
155,480	1,300	.0335	.0111	
161,460	1,350	.0362	.0123	
167,440	1,400	.0393	.0141	
173,420	1,450	.0431	.0160	
179,400	1,500	.0470	.0182	E (1,000–1,500)=1,938,000 pounds per square inch. Longitudinal wires buckle outward in three places.
.....	600	.0297	.0181	
.....	600	.0297	.0181	
185,380	1,550	.0512	.0206	
191,360	1,600	.0577	.0245	
197,340	1,650	.0673	.0318	Ultimate strength.

Opened longitudinal and oblique cracks in lower 2 feet of the column.

No. 1725.

1:3:6 Mixture.

Reënforced with steel wire cage, 3″ × 3″ meshes; 33 circular wires ″.145 diameter each, electrically welded ends; 13 longitudinal wires ″.104 diameter each; intersections electrically welded.



Composition, by volume: Alpha cement, 1; sand, 3; trap rock (¾″ to 1½″), 6. Water, 79.4 per cent of cement, by weight.

Age, set in air, 5 months 11 days.

Weight of column, total, 1,019 pounds.

Weight of concrete, 1,010 pounds = 149.6 pounds per cubic foot.

Weight of wire cage, 9 pounds.

Height of column, 97.65 inches.

Diameter of column, 12.35 inches.

Sectional area, gross, 119.79 square inches.

Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
11,979	100	0.	0.	Initial load. Loaded with 9,000 pounds before testing.
17,969	150	.0010	.0002	
23,958	200	.0023	.0005	
29,948	250	.0036	.0009	
35,937	300	.0047	.0010	
41,927	350	.0060	.0014	
47,916	400	.0073	.0018	
53,906	450	.0087	.0021	
59,895	500	.0102	.0026	
65,885	550	.0115	.0030	
71,874	600	.0134	.0038	E (100–600) = 2,604,000 pounds per square inch.
.....	600	.0137	.0039	
77,864	650	.0150	.0043	
83,853	700	.0168	.0049	
89,843	750	.0183	.0055	
95,832	800	.0202	.0065	
101,822	850	.0222	.0071	
107,811	900	.0245	.0083	
113,801	950	.0265	.0090	
119,790	1,000	.0293	.0105	E (600–1,000) = 2,174,000 pounds per square inch.
.....	600	.0218	.0106	
.....	600	.0217	.0106	

No. 1725—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
125,780	1,050	.0320	.0118	
131,769	1,100	.0350	.0135	
137,759	1,150	.0384	.0156	
143,748	1,200	.0425	.0180	
149,738	1,250	.0462	.0200	
155,727	1,300	.0500	.0224	
161,717	1,350	.0555	.0251	
167,706	1,400	.0600	.0279	
173,696	1,450	.0679	.0332	
179,685	1,500	.0748	.0372	E (1,000-1,500)=1,330,000 pounds per square inch.
.....	600	.0534	.0375	
.....	600	.0529	.0373	
185,675	1,550	.0868	.0467	
191,664	1,600	.0993	.0551	Longitudinal wires buckle outward.
197,654	1,650	.1120	.0640	
203,643	1,700	.1295	.0770	
.....	600	.0975	.0770	
.....	600	.0975	.0770	
206,000	1,720	.....	.....	Ultimate strength.

Opened longitudinal and oblique cracks at middle of height, concrete flaking off between wires of reënforcing cage.

NO. 1725.

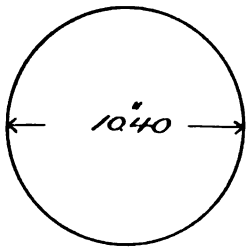
CONCRETE COLUMN, 1 : 3 : 6 MIXTURE, REENFORCED WITH STEEL WIRE CAGE, 3-INCH MESHES.

APPEARANCE AFTER COMPLETION OF TEST.

CAMPBELL ART CO.
ELIZABETH, N. J.

No 1734.

1:1 Mortar.
Plain column, without reënforcing metal.



Composition, by volume: Alpha cement, 1; sand, 1. Water, 38.9 per cent of cement, by weight.
Age, set in air, 6 months 11 days.
Weight of column, total, 627 pounds.
Weight of concrete, 627 pounds = 132.6 pounds per cubic foot.
Height of column, 96.25 inches.
Diameter of column, 10.40 inches.
Sectional area, 84.95 square inches.
Gauged length, 50″.
The temperature of the column was about 120° Fahr. when the mold was removed, 18 hours after gauging.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
8,495	100	0.	0.	Initial load. Loaded with 9,500 pounds before testing.
12,743	150	.0005	0.	
16,990	200	.0013	0.	
21,238	250	.0020	.0002	
25,485	300	.0030	.0003	
29,733	350	.0038	.0004	
33,980	400	.0047	.0005	
38,228	450	.0055	.0006	
42,475	500	.0065	.0007	
46,723	550	.0074	.0007	
50,970	600	.0083	.0009	E (100-600) = 3,378,000 pounds per square inch.
.....	600	.0083	.0007	
55,218	650	.0091	.0008	
59,465	700	.0100	.0010	
63,713	750	.0113	.0011	
67,960	800	.0120	.0011	
72,208	850	.0128	.0012	
76,455	900	.0137	.0014	
80,703	950	.0144	.0014	
84,950	1,000	.0154	.0017	E (600-1,000) = 3,175,000 pounds per square inch.
.....	600	.0093	.0016	
.....	600	.0093	.0016	
.....	200	.0025	.....	
.....	400	.0057	.....	
.....	600	.0093	.....	
.....	800	.0125	.....	
.....	1,000	.0155	.....	
.....	800	.0128	.....	
.....	600	.0095	.....	
.....	400	.0060	.....	
.....	200	.0025	.0016	

No. 1734—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
93,445	1,100	.0171	.0017	
101,940	1,200	.0192	.0019	
110,435	1,300	.0207	.0019	
118,930	1,400	.0225	.0022	
127,425	1,500	.0240	.0022	E (1,000–1,500) = 3,086,000 pounds per square inch.
.....	600	.0098	.0021	
.....	600	.0100	.0021	
.....	200	.0030	.....	
.....	400	.0061	.....	
.....	600	.0099	.....	
.....	800	.0132	.....	
.....	1,000	.0165	.....	
.....	800	.0136	.....	
.....	600	.0104	.....	
.....	400	.0066	.....	
.....	200	.0032	.0021	
135,920	1,600	.0258	.0025	
144,415	1,700	.0274	.0026	
152,910	1,800	.0293	.0028	
161,405	1,900	.0309	.0030	
.....	.....	.....	.....	Rested under initial load 1 hour.
169,900	2,000	.0321	.0026	E (1,500–2,000) = 3,247,000 pounds per square inch.
.....	600	.0104	.0026	
.....	600	.0104	.0026	
.....	200	.0035	.....	
.....	400	.0067	.....	
.....	800	.0138	.....	
.....	1,200	.0202	.....	
.....	1,600	.0262	.....	
.....	2,000	.0323	.....	
.....	1,600	.0268	.....	
.....	1,200	.0210	.....	
.....	800	.0148	.....	
.....	400	.0076	.....	
.....	200	.0040	.0030	
178,395	2,100	.0342	.0032	
186,890	2,200	.0360	.0033	
195,385	2,300	.0377	.0036	
203,880	2,400	.0394	.0039	
212,375	2,500	.0413	.0041	E (2,000–2,500) = 3,247,000 pounds per square inch.
.....	600	.0119	.0040	
.....	600	.0118	.0040	
220,870	2,600	.0430	.0042	
229,365	2,700	.0448	.0045	
237,860	2,800	.0470	.0048	
246,355	2,900	.0486	.0050	
254,850	3,000	.0507	.0053	E (2,500–3,000) = 3,049,000 pounds per square inch.
.....	600	.0132	.0051	
.....	600	.0131	.0050	
263,345	3,100	.0523	.0054	
271,840	3,200	.0547	.0060	
280,335	3,300	.0569	.0061	
288,830	3,400	.0589	.0066	
297,325	3,500	.0619	.0078	E (3,000–3,500) = 2,874,000 pounds per square inch.
.....	600	.0157	.0076	
.....	600	.0155	.0075	
.....	200	.0083	.....	
.....	400	.0115	.....	
.....	800	.0186	.....	
.....	1,200	.0253	.....	
.....	1,600	.0316	.....	
.....	2,000	.0379	.....	
.....	2,400	.0440	.....	

No. 1734—Continued.

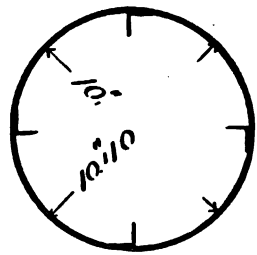
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
.....	2,800	.0504	.....	
.....	3,200	.0570	.....	
.....	2,800	.0514	.....	
.....	2,400	.0455	.....	
.....	2,000	.0398	.....	
.....	1,600	.0339	.....	
.....	1,200	.0275	.....	
.....	800	.0210	.....	
.....	400	.0130	.....	
.....	200	.0091	.0078	
.....	.....	.....	.0060	Set after 20 minutes' rest.
.....	200	.0072	.....	
.....	400	.0106	.....	
.....	800	.0179	.....	
.....	1,200	.0246	.....	
.....	1,600	.0309	.....	
.....	2,000	.0373	.....	
.....	1,600	.0316	.....	
.....	1,200	.0357	.....	
.....	800	.0192	.....	
.....	400	.0118	.....	
.....	200	.0080	.0068	
.....	200	.0079	.....	
.....	400	.0113	.....	
.....	600	.0150	.....	
.....	800	.0186	.....	
.....	1,000	.0220	.....	
.....	800	.0189	.....	
.....	600	.0153	.....	
.....	400	.0117	.....	
.....	200	.0080	.0068	
.....	.....	.....	.....	Rested under about 150 pounds per square inch 16 hours.
.....	100	.....	.0062	
.....	200	.0073	.....	
.....	400	.0104	.....	
.....	600	.0144	.....	
.....	800	.0179	.....	
.....	1,000	.0212	.....	
.....	800	.0182	.....	
.....	600	.0148	.....	
.....	400	.0111	.....	
.....	200	.0078	.0067	
305,820	3,600	.0630	.0079	
314,315	3,700	.0656	.0083	
322,810	3,800	.0675	.0086	
331,305	3,900	.....	.....	
367,000	4,320	.....	.....	Ultimate strength.

At 3,900 pounds per square inch compression an oblique crack opened, 2 feet long, at the upper end of the column. Continuing the loads, no further development of cracks occurred until the maximum stress was reached, when there was sudden rupture of about 3 feet of the length of the column, at the upper end. Oblique cracks were opened, detaching wedge-shaped pieces. A transverse crack, nearly normal to the axis, separated the column at a place 10 inches from the middle of its height.

No. 1735.

1:1 Mortar.

Reënforced with 25 hoops, 1″.50 wide by ″.12 thick, and four 1″×1″ by 96″.04 steel angle bars. Hoops spaced 4″ apart, center to center.



Composition, by volume: Alpha cement, 1; sand, 1. Water, 37.8 per cent of cement, by weight.

Age, set in air, 6 months 12 days.

Weight of column, total, 678 pounds.

Weight of concrete, 606 pounds = 132.6 pounds per cubic foot.

Weight of cage, complete, 72 pounds.

Height of column, 96.04 inches.

Diameter of column, 10.40 inches.

Sectional area, gross, 84.95 square inches.

Sectional area of angle bars, 0.91 square inch.

Gauged length, 50″.

The temperature of the column was about 120° Fahr. when the mold was removed, 18 hours after gauging.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
8,495	100	0.	0.	Initial load. Loaded with 8,500 pounds before testing.
12,743	150	.0010	.0003	
16,990	200	.0021	.0005	
21,238	250	.0033	.0006	
25,485	300	.0045	.0008	
29,733	350	.0056	.0009	
33,980	400	.0067	.0009	
38,228	450	.0077	.0010	
42,475	500	.0087	.0011	
46,723	550	.0097	.0011	Rested under initial load ½ hour.
50,970	600	.0104	.0009	E (100–600) = 2,632,000 pounds per square inch.
.....	600	.0105	.0009	
55,218	650	.0116	.0009	
59,465	700	.0125	.0010	
63,713	750	.0134	.0010	
67,960	800	.0144	.0011	
72,208	850	.0152	.0011	
76,455	900	.0160	.0012	
80,703	950	.0170	.0013	
84,950	1,000	.0179	.0014	E (600–1,000) = 2,857,000 pounds per square inch.
.....	600	.0116	.0011	
.....	600	.0116	.0012	
93,445	1,100	.0196	.0014	
101,940	1,200	.0211	.0014	
110,435	1,300	.0229	.0015	
118,930	1,400	.0245	.0016	
127,425	1,500	.0261	.0016	E (1,000–1,500) = 3,125,000 pounds per square inch.

No. 1735—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
.....	600	.0121	.0017	
.....	600	.0121	.0016	
135,920	1,600	.0278	.0018	
144,415	1,700	.0293	.0019	
152,910	1,800	.0310	.0022	
161,405	1,900	.0327	.0021	
169,900	2,000	.0342	.0025	E (1,500–2,000)=3,472,000 pounds per square inch.
.....	600	.0130	.0022	
.....	600	.0130	.0023	
178,395	2,100	.0358	.0023	
186,890	2,200	.0377	.0023	
195,385	2,300	.0392	.0028	
203,880	2,400	.0408	.0032	
212,375	2,500	.0424	.0029	E (2,000–2,500)=3,676,000 pounds per square inch.
.....	600	.0140	.0029	
.....	600	.0139	.0030	
220,870	2,600	.0437	.0030	
229,365	2,700	.0456	.0034	
237,860	2,800	.0475	.0037	
246,355	2,900	.0491	.0040	
254,850	3,000	.0509	.0043	E (2,500–3,000)=3,086,000 pounds per square inch.
.....	600	.0152	.0040	
.....	600	.0151	.0040	
263,375	3,100	.0528	.0044	
271,840	3,200	.0546	.0049	
280,335	3,300	.0565	.0051	
288,830	3,400	.0581	.0053	
297,325	3,500	.0600	.0057	E (3,000–3,500)=3,247,000 pounds per square inch.
.....	600	.0170	.0056	
.....	600	.0167	.0056	
305,820	3,600	.0619	.0060	
314,315	3,700	.0639	.0068	
322,810	3,800	.0654	.0070	
331,305	3,900	.0677	.0079	
339,800	4,000	.0695	.0080	E (3,500–4,000)=3,472,000 pounds per square inch.
.....	600	.0191	.0080	
.....	600	.0190	.0080	
348,295	4,100	.0715	.0089	
356,790	4,200	.0737	.0097	
365,285	4,300	.0760	.0101	
373,780	4,400	.0785	.0111	
382,275	4,500	.0810	.0121	E (4,000–4,500)=3,378,000 pounds per square inch.
.....	600	.0221	.0118	
.....	600	.0221	.0116	
390,770	4,600	.0834	.0128	
399,265	4,700	.0865	.0141	
407,760	4,800	.0890	.0156	
416,255	4,900	.0915	.0165	
424,750	5,000	.0491	.0175	E (4,500–5,000)=3,247,000 pounds per square inch.
.....	600	.0271	.0171	
.....	600	.0270	.0170	
.....	.....	.....	.....	Remained under a load of 150 pounds per square inch 40 hours.

No. 1735—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
.....	100	.....	.0154	
433,245	5,100	.0950	.0180	
441,740	5,200	.0977	.0190	
450,235	5,300	.1024	.0218	
458,730	5,400	.1122	.0230	
467,225	5,500	.1169	.0296	E (5,000–5,500)=2,336,000 pounds per square inch.
.....	600	.0380	.0286	
.....	600	.0379	.0286	
475,720	5,600	.1215	.0312	
484,215	5,700	.1272	.0344	
.....	600	.0427	.0334	
.....	600	.0426	.0334	
.....	200	.0350	.....	
.....	400	.0386	.....	
.....	600	.0423	.....	
.....	800	.0459	.....	
.....	1,000	.0494	.....	
.....	800	.0464	.....	
.....	600	.0430	.....	
.....	400	.0393	.....	
.....	200	.0353	.0333	
.....	200	.0347	.....	
.....	400	.0383	.....	
.....	800	.0454	.....	
.....	1,200	.0525	.....	
.....	1,600	.0595	.....	
.....	2,000	.0661	.0333	
.....	2,000	.0659	.....	
.....	1,600	.0605	.....	
.....	1,200	.0554	.....	
.....	800	.0475	.....	
.....	400	.0396	.....	
.....	200	.0356	.0334	
508,000	5,980	.....	.....	Ultimate strength.

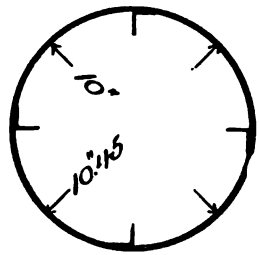
Column failed at upper end. The mortar was broken up over a length of column of 20 inches. Angles buckled between hoops after reaching the maximum load, and while the total stress was gradually falling.

When the resistance had dropped to 350,000 pounds, rupture of the third hoop took place across the rivet hole. Accompanying the rupture of this hoop was a further sudden loss in resistance of the column.

No. 1730.

1 : 1 : 2 Mixture.

Reënforced with 25 hoops, each 1″.50 wide by ″.12 thick, and four 1″ × 1″ by 96″.10 steel angle bars. Hoops spaced 4″ apart, center to center.



Composition, by volume: Alpha cement, 1; sand, 1; trap rock (¼″ to 1½″), 2. Water, 38.8 per cent of cement, by weight.

Age, set in air, 5 months.

Weight of column, total, 761 pounds.

Weight of concrete, 689 pounds =149.1 pounds per cubic foot.

Weight of cage, complete, 72 pounds.

Height of column, 96.10 inches.

Diameter of column, 10.45 inches.

Sectional area, gross, 85.77 square inches.

Sectional area of angle bars, 0.91 square inch.

Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
8,577	100	0.	0.	Initial load. Loaded with 6,000 pounds before testing.
12,866	150	.0007	0.	
17,154	200	.0013	.0001	
21,443	250	.0019	.0002	
25,731	300	.0025	.0005	
30,020	350	.0033	.0007	
34,308	400	.0040	.0007	
38,597	450	.0047	.0007	
42,885	500	.0054	.0008	
47,174	550	.0063	.0008	
51,462	600	.0069	.0009	E (100–600)=4,167,000 pounds per square inch.
.....	600	.0069	.0010	
55,751	650	.0075	.0010	
60,039	700	.0083	.0010	
64,328	750	.0090	.0010	
68,616	800	.0098	.0011	
72,905	850	.0106	.0013	
77,193	900	.0116	.0016	
81,482	950	.0123	.0018	
85,770	1,000	.0130	.0018	E (600–1,000)=3,846,000 pounds per square inch.
.....	600	.0081	.0018	
.....	600	.0081	.0018	
94,347	1,100	.0144	.0019	
102,924	1,200	.0160	.0020	
111,501	1,300	.0173	.0021	
120,078	1,400	.0189	.0023	
128,655	1,500	.0205	.0023	E (1,000–1,500)=3,571,000 pounds per square inch.
.....	600	.0091	.0023	
.....	600	.0092	.0023	

No. 1730—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
137,232	1,600	.0219	.0024	
145,809	1,700	.0238	.0025	
154,386	1,800	.0251	.0026	Rested under initial load 30 minutes. Set at end of rest, .0014. Change in temperature of room.
162,963	1,900	.0261	.0019	
171,540	2,000	.0285	.0024	E (1,500–2,000)=3,165,000 pounds per square inch.
.....	600	.0101	.0021	
.....	600	.0101	.0022	
180,117	2,100	.0303	.0028	
188,694	2,200	.0324	.0030	
197,271	2,300	.0349	.0036	
205,848	2,400	.0371	.0039	
214,425	2,500	.0396	.0046	E (2,000–2,500)=2,809,000 pounds per square inch.
.....	600	.0133	.0047	
.....	600	.0134	.0046	
223,002	2,600	.0431	.0061	
231,579	2,700	.0452	.0064	
240,156	2,800	.0483	.0073	
248,733	2,900	.0510	.0080	Snapping sound.
257,310	3,000	.0544	.0090	E (2,500–3,000)=2,404,000 pounds per square inch.
.....	600	.0192	.0090	
.....	600	.0190	.0089	
265,887	3,100	.0574	.0100	
274,464	3,200	.0614	.0114	
283,041	3,300	.0645	.0134	
291,618	3,400	.0680	.0144	
300,195	3,500	.0723	.0163	E (3,000–3,500)=2,358,000 pounds per square inch.
.....	600	.0276	.0163	
.....	600	.0270	.0162	
308,772	3,600	.0762	.0184	
317,349	3,700	.0810	.0209	
325,926	3,800	.0849	.0230	
334,503	3,900	.0898	.0256	
343,080	4,000	.0945	.0286	E (3,500–4,000)=2,525,000 pounds per square inch.
.....	600	.0396	.0283	
.....	600	.0394	.0283	
351,657	4,100	.0996	.0318	
360,234	4,200	.1058	.0354	First crack observed, occurring between hoops.
368,811	4,300	.1110	.0381	
.....	600	.0487	.0377	
.....	600	.0486	.0376	
377,388	4,400	.1167	.0425	
385,965	4,500	.1244	.0473	E (4,000–4,500)=2,232,000 pounds per square inch.
.....	600	.0580	.0466	
.....	600	.0577	.0466	
394,542	4,600	.1315	.0516	
403,119	4,700	.1388	.0569	
411,696	4,800	.1472	.0632	
.....	600	.0734	.0622	
.....	600	.0731	.0621	
25,000	.....	.....	.....	Column rested under this load 40 hours.
.....	100	.....	.0614	
.....	600	.0725	.0615	
.....	600	.0715	.0615	
.....	600	.0718	.0615	
.....	200	.0634	.....	
.....	300	.0651	.....	
.....	400	.0673	.....	

No. 1730—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
.....	500	.0697	.....	
.....	600	.0716	.....	
.....	700	.0739	.....	
.....	800	.0764	.....	
.....	900	.0785	.....	
.....	1,000	.0808	.....	Sustained 1,000 pounds 30 minutes. Compression was then ".0813.
.....	900	.0785	.....	
.....	800	.0783	.....	
.....	700	.0767	.....	
.....	600	.0748	.....	
.....	500	.0738	.....	
.....	400	.0703	.....	
.....	300	.0676	.....	
.....	200	.0649	.0624	
.....	200	.0636	.....	
.....	400	.0680	.....	
.....	600	.0727	.....	
.....	800	.0770	.....	
.....	1,000	.0810	.....	
.....	1,200	.0852	.....	
.....	1,400	.0893	.....	
.....	1,600	.0933	.....	
.....	1,800	.0971	.....	
.....	2,000	.1010	.....	
.....	1,800	.0989	.....	
.....	1,600	.0962	.....	
.....	1,400	.0933	.....	
.....	1,200	.0901	.....	
.....	1,000	.0866	.....	
.....	800	.0824	.....	
.....	600	.0779	.....	
.....	400	.0724	.....	
.....	200	.0660	.0631	
.....	200	.0648	.....	
.....	400	.0690	.....	
.....	800	.0784	.....	
.....	1,200	.0869	.....	
.....	1,600	.0947	.....	
.....	2,000	.1014	.....	
.....	2,400	.1084	.....	
.....	2,800	.1151	.....	
.....	3,200	.1220	.....	
.....	3,600	.1287	.....	
.....	4,000	.1354	.....	
.....	3,600	.1325	.....	
.....	3,200	.1281	.....	
.....	2,800	.1235	.....	
.....	2,400	.1180	.....	
.....	2,000	.1124	.....	
.....	1,600	.1059	.....	
.....	1,200	.0985	.....	
.....	800	.0895	.....	
.....	400	.0780	.....	
.....	200	.0703	.0664	Set after 5 minutes, ".0654.
.....	200	.0673	.....	
.....	400	.0720	.....	
.....	800	.0816	.....	
.....	1,200	.0905	.....	
.....	1,600	.0985	.....	
.....	2,000	.1063	.....	
.....	1,600	.1011	.....	
.....	1,200	.0948	.....	
.....	800	.0868	.....	
.....	400	.0759	.....	
.....	200	.0694	.0660	

Measurements of longitudinal compression discontinued.

No. 1730—Continued.

Observations made on lateral expansion of tenth hoop from lower end of column. This hoop, when struck lightly, sounds as though it was without tension, or slightly loose, when the initial load only is on the column.

Applied loads.		Lateral expansion of hoop.	Remarks.
Total.	Per square inch.		
Pounds.	*Pounds.*	*Inch.*	
.....	100	0.	Initial load.
.....	1,000	.0002	
.....	2,000	.0004	
.....	3,000	.0007	
.....	4,000	.0011	
.....	100	.0002	

Observations on ninth hoop from lower end. This hoop, when struck, "rings" and appears to be tight initially.

Applied loads.		Lateral expansion of hoop.	Remarks.
Total.	Per square inch.		
Pounds.	*Pounds.*	*Inch.*	
.....	100	0.	Initial load.
.....	1,000	.0008	
.....	2,000	.0018	
.....	3,000	.0024	
.....	4,000	.0033	
.....	100	—.0001	

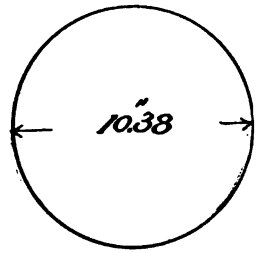
Observations made on seventeenth hoop from lower end of the column. The concrete in the vicinity of this hoop developed cracks during the preceding part of this test. The hoop itself appears tight initially.

Applied loads.		Lateral expansion of hoop.	Remarks.
Total.	Per square inch.		
Pounds.	*Pounds.*	*Inch.*	
.....	100	0.	Initial load.
.....	1,000	.0016	
.....	2,000	.0036	
.....	3,000	.0056	
.....	4,000	.0071	
.....	100	.0002—	
466,000	5,433	.....	Ultimate strength.

Failure occurred chiefly at the middle of its height. The concrete disintegrated, expanded, and eventually burst one of the hoops, the seventeenth from the lower end. At the time of rupture of this hoop the resistance of the column had dropped to 420,000 pounds.

No. 1736.

1:4 Mortar.
Plain column, without reënforcing metal.



Composition, by volume: Alpha cement, 1; sand, 4. Water, 72.6 per cent of cement, by weight.
Age, set in air, 6 months 8 days.
Weight of column, total, 559 pounds.
Weight of concrete, 559 pounds = 118.7 pounds per cubic foot.
Height of column, 96.25 inches.
Diameter of column, 10.38 inches.
Sectional area, 84.62 square inches.
Gauged length, 50″.

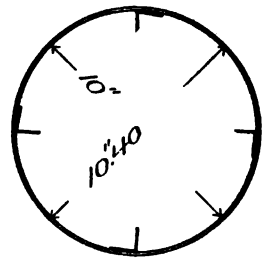
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
8,462	100	0.	0.	Initial load. Loaded with 9,000 pounds before testing.
12,693	150	.0020	.0002	
16,924	200	.0041	.0006	
21,155	250	.0064	.0010	
25,386	300	.0078	.0014	
29,617	350	.0112	.0021	
33,848	400	.0140	.0027	
38,079	450	.0165	.0033	
42,310	500	.0193	.0039	
46,441	550	.0228	.0048	
50,772	600	.0260	.0057	E (100–600) = 1,232,000 pounds per square inch.
.....	600	.0269	.0066	
55,003	650	.0300	.0073	
59,234	700	.0341	.0087	
63,465	750	.0379	.0100	
67,696	800	.0421	.0114	
71,927	850	.0474	.0140	
76,158	900	.0535	.0164	
.....	200	.0202	.....	
.....	300	.0252	.....	
.....	400	.0300	.....	
.....	500	.0350	.....	
.....	600	.0399	.....	
.....	500	.0363	.....	
.....	400	.0322	.....	
.....	300	.0275	.....	
.....	200	.0223	.0168	
80,389	950	.0600	.0198	
84,620	1,000	.0672	.0234	E (600–1,000) = 851,000 pounds per square inch.
.....	600	.0490	.0234	
.....	600	.0488	.0234	
88,851	1,050	.....	.....	Ultimate strength.

After observing the last permanent set the column ruptured upon reapplication of 88,000 pounds total load. Wedge-shaped fragments were developed at the lower end of the column, covering a section from 10″ to 24″ from the end.

No. 1737.

1:4 Mortar.

Reënforced with 25 hoops, 1″.50 wide by ″.12 thick and four 1″ × 1″ by 96″ steel angle bars. Hoops spaced 4″ apart, center to center.



Composition, by volume: Alpha cement, 1; sand, 4. Water, 63.5 per cent of cement, by weight.

Age, set in air, 6 months 8 days.

Weight of column, total, 620 pounds.

Weight of concrete, 548 pounds = 119.9 pounds per cubic foot.

Weight of cage, complete, 72 pounds.

Height of column, 96 inches.

Diameter of column, 10.40 inches.

Sectional area, 84.95 square inches.

Sectional area of angle bars, 0.91 square inch.

Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
8,495	100	0.	0.	Initial load. Loaded with 9,500 pounds before testing.
12,743	150	.0027	.0003	
16,990	200	.0060	.0010	
21,238	250	.0091	.0014	
25,485	300	.0121	.0022	
29,733	350	.0150	.0024	
33,980	400	.0175	.0024	
38,228	450	.0199	.0028	
42,475	500	.0220	.0028	
46,723	550	.0241	.0029	
50,970	600	.0263	.0030	E (100–600) = 1,073,000 pounds per square inch.
.....	600	.0265	.0031	
55,218	650	.0285	.0034	
59,465	700	.0305	.0036	
63,713	750	.0327	.0040	
67,960	800	.0348	.0040	
72,208	850	.0369	.0043	
76,455	900	.0390	.0045	
80,703	950	.0409	.0045	
84,950	1,000	.0430	.0048	E (600–1,000) = 1,342,000 pounds per square inch.
.....	600	.0306	.0048	
.....	600	.0304	.0045	
93,445	1,100	.0470	.0045	
101,940	1,200	.0525	.0053	Micrometer reset.
110,435	1,300	.0583	.0076	
118,930	1,400	.0646	.0107	
127,425	1,500	.0722	.0160	E (1,000–1,500) = 1,389,000 pounds per square inch.
.....	600	.0417	.0159	
.....	600	.0414	.0160	

No. 1737—Continued.

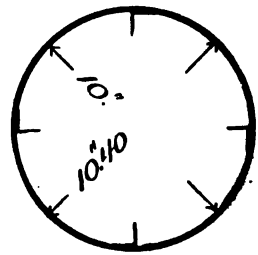
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
135,920	1,600	.0806	.0218	
144,415	1,700	.0910	.0298	
152,910	1,800	.1056	.0405	
161,405	1,900	.1234	.0541	
169,900	2,000	.1440	.0704	E (1,500–2,000)=1,437,000 pounds per square inch.
.....	600	.0920	.0704	
.....	600	.0914	.0702	
178,395	2,100	.1638	.0859	
186,890	2,200	.1874	.1057	
195,385	2,300	.2150	.1284	
203,880	2,400	.2460	.1531	
212,375	2,500	.2879	.1878	E (2,000–2,500)=943,000 pounds per square inch.
.....	600	.2965	.1880	
.....	600	.2963	.1880	
235,000	2,766	.....	.....	Ultimate strength.

Wedge-shaped fragments of mortar were detached from the surface of the column, between the hoops. Cracks were generally developed after the loads had reached 2,500 pounds per square inch, and increased as the loads were advanced.

No. 1733.

1 : 4 : 8 Mixture.

Reënforced with 25 hoops, each 1″.50 wide by ″.12 thick, and four 1″×1″ by 96″ steel angle bars. Hoops spaced 4″ apart, center to center.



Composition, by volume: Alpha cement, 1; sand, 4; trap rock (¾″ to 1½″), 8. Water, 113.4 per cent of cement, by weight.

Age, set in air, 6 months 11 days.

Weight of column, total, 742 pounds.

Weight of concrete, 670 pounds = 146.6 pounds per cubic foot.

Weight of cage, complete, 72 pounds.

Height of column, 96 inches.

Diameter of column, 10.40 inches.

Sectional area, gross, 84.95 square inches.

Sectional area of angle bars, 0.91 square inch.

Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
8,495	100	0.	0.	Initial load. Loaded with 9,500 pounds before testing.
12,743	150	.0023	.0005	
16,990	200	.0050	.0015	
21,238	250	.0076	.0023	
25,485	300	.0101	.0029	
29,733	350	.0128	.0037	
33,980	400	.0150	.0042	
38,228	450	.0175	.0048	
42,475	500	.0200	.0056	
46,723	550	.0226	.0060	
50,970	600	.0250	.0064	E (100–600) = 1,344,000 pounds per square inch.
.....	600	.0255	.0068	
55,218	650	.0281	.0072	
59,465	700	.0310	.0078	
63,713	750	.0332	.0082	
67,960	800	.0363	.0087	
72,208	850	.0390	.0081	
76,455	900	.0423	.0098	
80,703	950	.0463	.0105	
84,950	1,000	.0493	.0113	E (600–1,000) = 1,000,000 pounds per square inch.
.....	600	.0385	.0112	
.....	600	.0385	.0113	
93,445	1,100	.0550	.0125	
101,940	1,200	.0631	.0151	
110,435	1,300	.0718	.0188	
118,930	1,400	.0830	.0255	

No. 1733—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
127,425	1,500	.0458	.0350	E (1,000-1,500) = 1,096,000 pounds per square inch.
.....	600	.0678	.0352	
.....	600	.0673	.0352	
.....	200	.0434	.....	
.....	300	.0512	.....	
.....	400	.0577	.....	
.....	500	.0629	.....	
.....	600	.0670	.....	
.....	500	.0642	.....	
.....	400	.0600	.....	
.....	300	.0540	.....	
.....	200	.0452	.0351	
.....	300	.0435	.....	
.....	400	.0579	.....	
.....	600	.0670	.....	
.....	800	.0749	.....	
.....	1,000	.0817	.....	
.....	800	.0770	.....	
.....	600	.0710	.....	
.....	400	.0617	.....	
.....	200	.0459	.0353	
18,000	212	.....	.....	Rested 16 hours.
.....	100	.....	.0345	
.....	600	.0668	.0348	
.....	600	.0668	.0350	
135,920	1,600	.1084	.0452	
144,415	1,700	.1245	.0506	
152,910	1,800	.1435	.0775	
.....	600	.1055	.0774	
.....	600	.1051	.0774	
161,405	1,900	.1632	.0958	
169,900	2,000	.1840	.1123	Fine longitudinal crack in upper half of column E (1,500-2,000) = 2,294,000 pounds per square inch.
.....	600	.1386	.1124	
.....	600	.1384	.1124	
178,395	2,100	.2030	.1298	
186,890	2,200	.2285	.1529	
.....	600	.1774	.1528	
.....	600	.1774	.1528	
195,385	2,300	.2525	.1724	
203,880	2,400	.2745	.1928	
212,375	2,500	.3005	.2156	E (2,000-2,500) = 1,894,000 pounds per square inch.
.....	600	.2393	.2160	
.....	600	.2392	.2163	
.....	100	.....	.2157	Set after 10 minutes.
.....	200	.2200	.....	
.....	300	.2250	.....	
.....	400	.2299	.....	
.....	500	.2350	.....	
.....	600	.2395	.....	
.....	500	.2307	.....	
.....	400	.2333	.....	
.....	300	.2287	.....	
.....	200	.2230	.2174	
.....	200	2215	.....	
.....	700	.2310	.....	
.....	000	.2398	.....	
.....	800	.2483	.....	
.....	1,000	.2564	.....	
.....	800	.2515	.....	
.....	600	.2448	.....	
.....	400	.2361	.....	
.....	200	.2248	.2185	
.....	200	.2228	.....	
.....	400	.2325	.....	
.....	800	.2500	.....	
.....	1,200	.2662	.....	

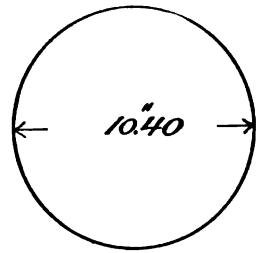
No. 1733—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
.....	1,600	.2791	.....	
.....	2,000	.2927	.....	
.....	1,600	.2855	.....	
.....	1,200	.2758	.....	
.....	800	.2630	.....	
.....	400	.2437	.....	
.....	200	.2303	.2228	
255,000	3,002	.....	.....	Ultimate strength.

Height of column at time of reaching maximum load, 94″.85. Cracks developed generally throughout the length of the column as the loads advanced from 2,000 to 3,002 pounds per square inch. The cracks opened in the concrete between the hoops, both longitudinal and circular in direction. The column deflected laterally $1\frac{3}{4}$″ at the middle of its height. The load gradually dropped to 240,000 pounds, when one hoop near middle of height fractured across the first rivet hole. The resistance of the column then suddenly dropped to about 210,000 pounds. The test was then discontinued.

No. 1731.

1:2:4 Mixture.
Plain column, without reënforcing metal.



Composition, by volume: Alpha cement, 1; sand, 2; trap rock ($\frac{3}{4}$" to 1$\frac{1}{2}$"), 4. Water, 56.7 per cent of cement, by weight.
Age, set in air, 5 months 16 days.
Weight of column, total, 711 pounds.
Weight of concrete, 711 pounds = 150 pounds per cubic foot.
Height of column, 96.30 inches.
Diameter of column, 10.40 inches.
Sectional area, 84.95 square inches.
Gauged length, 50".

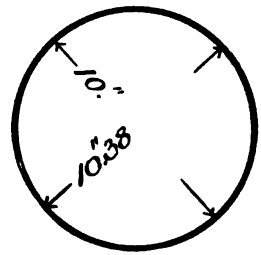
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
8,495	100	0.	0.	Initial load. Loaded with 4,000 pounds before testing.
12,743	150	.0007	0.	
16,990	200	.0014	.0002	
21,238	250	.0022	.0007	
25,485	300	.0029	.0005	
29,733	350	.0038	.0007	
33,980	400	.0048	.0008	
38,228	450	.0057	.0010	
42,475	500	.0066	.0011	
46,723	550	.0077	.0013	
50,970	600	.0086	.0015	E (100–600) 3,521,000 pounds per square inch.
.....	600	.0091	.0018	
55,218	650	.0100	.0019	
59,465	700	.0111	.0022	
63,713	750	.0120	.0023	
67,960	800	.0132	.0026	
72,208	850	.0142	.0030	
76,455	900	.0155	.0033	
80,703	950	.0165	.0036	
84,950	1,000	.0177	.0038	E (600–1,000) 2,941,000 pounds per square inch.
.....	600	.0118	.0039	
.....	600	.0118	.0039	
93,445	1,100	.0202	.0045	
101,940	1,200	.0229	.0053	
110,435	1,300	.0260	.0065	
118,930	1,400	.0292	.0075	
120,000	1,413	.....	.....	Ultimate strength.

Opened oblique and longitudinal cracks in lower 2 feet of the column.

No. 1740.

1:2:4 Mixture.

Reënforced with 13 hoops, each 1″.50 wide by ″.12 thick. Hoops spaced 8″ apart, center to center.



Composition, by volume: Alpha cement, 1; sand, 2; trap rock (¾″ to 1½″), 4. Water, 62.4 per cent of cement, by weight.

Age, set in air, 6 months 6 days.

Weight of column, total, 720 pounds.

Weight of concrete, 695.5 pounds = 149.2 pounds per cubic foot.

Weight of hoops, 24.5 pounds.

Height of column, 96.25 inches.

Diameter of column, 10.38 inches.

Sectional area, gross, 84.62 square inches.

Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
8,462	100	0.	0.	Initial load. Loaded with 7,000 pounds before testing.
12,693	150	.0006	0.	
16,924	200	0016	.0002	
21,155	250	.0026	.0003	
25,386	300	.0037	.0005	
29,617	350	.0048	.0006	
33,848	400	.0062	.0009	
38,079	450	..0074	.0013	
42,310	500	.0088	.0016	
46,541	550	.0101	.0019	
50,772	600	.0118	.0027	E (100-600) = 2,747,000 pounds per square inch.
.....	600	.0120	.0029	
.....	.....	.....	.....	Rested under initial load 14 hours; micrometer reading now ″.0040.
.....	600	.0129	.0040	
55,003	650	.0138	.0040	
59,234	700	.0149	.0041	
63,465	750	.0166	.0048	
67,696	800	.0186	.0061	
71,927	850	.0209	.0068	
76,158	900	.0234	.0078	
80,389	950	.0261	.0090	
84,620	1,000	.0284	.0102	E (600-1,000) = 2,198,000 pounds per square inch.
.....	600	.0210	.0104	
.....	600	.0208	.0102	
93,082	1,100	.0342	.0135	
101,544	1,200	.0409	.0178	
110,006	1,300	.0497	.0226	
118,468	1,400	.0585	.0297	
126,930	1,500	.0684	.0346	E (1,000-1,500) = 1,603,000 pounds per square inch.

No. 1740—Continued.

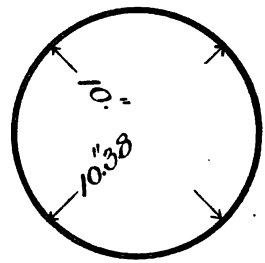
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
.....	600	.0490	.0347	
.....	600	.0490	.0347	
135,392	1,600	.0815	.0437	
143,854	1,700	.0970	.0539	Cracks opened about 3 feet from lower end of column.
152,316	1,800	.1131	.0643	
160,778	1,900	.1292	.0750	
169,240	2,000	.1515	.0914	E (1,500-2,000)=951,000 pounds per square inch.
.....	600	.1120	.0911	
.....	600	.1113	.0910	
188,900	2,232	.....	.....	Ultimate strength.

The column was shortened in length $\frac{3}{8}''$ at the time of reaching the maximum load. There was a gradual loss in resistance, and the test was discontinued when the resistance had fallen to 160,000 pounds. Failure was local in two sections between hoops located 24″, 32″, and 40″, respectively, from the lower end of the column.

No. 1741.

1:2:4 Mixture.

Reënforced with 25 hoops, each 1″.50 wide by ″.12 thick. Hoops spaced 4″ apart, center to center.



Composition, by volume: Alpha cement, 1; sand, 2; trap rock ($\frac{3}{4}$″ to 1$\frac{1}{2}$″), 4. Water, 62.4 per cent of cement, by weight.

Age, set in air, 6 months 5 days.

Weight of column, total, 732 pounds.

Weight of concrete, 685 pounds = 148.6 pounds per cubic foot.

Weight of hoops, 47 pounds.

Height of column, 96.10 inches.

Diameter of column, 10.38 inches.

Sectional area, gross, 84.62 square inches.

Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
8,462	100	0.	0.	Initial load. Loaded with 8,000 pounds before testing.
12,693	150	.0010	.0002	
16,924	200	.0018	.0004	
21,155	250	.0029	.0007	
25,386	300	.0040	.0009	
29,617	350	.0052	.0012	
33,848	400	.0064	.0016	
38,079	450	.0078	.0020	
42,310	500	.0090	.0029	
46,541	550	.0104	.0030	
50,772	600	.0118	.0031	E (100-600) 2,874,000 pounds per square inch.
.....	600	.0121	.0034	
55,003	650	.0134	.0038	
59,234	700	.0147	.0042	
63,465	750	.0164	.0048	
67,696	800	.0180	.0054	
71,927	850	.0194	.0060	
76,158	900	.0214	.0068	
80,389	950	.0233	.0078	
84,620	1,000	.0252	.0086	E (600-1,000) =2,532,000 pounds per square inch.
.....	600	.0185	.0087	
.....	600	.0185	.0086	
93,082	1,100	.0290	.0102	
101,544	1,200	.0354	.0140	
110,006	1,300	.0396	.0160	
118,468	1,400	.0466	.0197	
126,930	1,500	.0529	.0235	E (1,000-1,500) =1,953,000 pounds per square inch.
.....	600	.0358	.0234	
.....	600	.0358	.0235	

No. 1741—Continued.

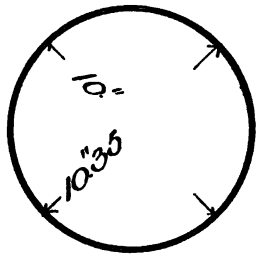
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
135,392	1,600	.0608	.0280	
143,854	1,700	.0690	.0330	
152,316	1,800	.0783	.0389	
160,778	1,900	.0875	.0444	
169,240	2,000	.0970	.0501	E (1,500-2,000)=1,429,000 pounds per square inch.
.....	600	.0658	.0500	
.....	600	.0655	.0500	
177,702	2,100	.1060	.0554	
186,164	2,200	.1180	.0642	Crack opened in concrete 25″ from lower end of column.
194,626	2,300	.1288	.0705	
203,088	2,400	.1450	.0828	
211,550	2,500	.1538	.0881	E (2,000-2,500)=1,330,000 pounds per square inch.
.....	600	.1066	.0879	
.....	600	.1060	.0876	
220,012	2,600	.1672	.0966	
228,474	2,700	.1815	.1088	
236,936	2,800	.1940	.1160	
.....	600	.1356	.1155	
.....	600	.1349	.1150	
290,100	3,428	.....	.....	Ultimate strength.

Column failed 2 feet from the upper end. The load fell from the maximum to about 288,000 pounds, when the seventh hoop fractured across the first rivet hole. The total height of the column was 95″.4, measured immediately after the fracture of the hoop.

No. 1739.

1: 2: 4 Mixture.

Reënforced with 47 hoops, each 1″.50 wide by ″.12 thick. Hoops spaced 2″ apart, center to center.



Composition, by volume: Alpha cement, 1; sand, 2; trap rock (¾″ to 1½″), 4. Water, 62.4 per cent of cement, by weight.

Age, set in air, 6 months 6 days.

Weight of column, total, 761 pounds.

Weight of concrete, 672.5 pounds = 149.4 pounds per cubic foot.

Weight of hoops, 88.5 pounds.

Height of column, 96.15 inches.

Diameter of column, 10.35 inches.

Sectional area, gross, 84.13 square inches.

Gauged length of 50″ established on hoops. The majority of the hoops were loose over the concrete, some slightly and some decidedly so, at the commencement of the test.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
8,413	100	0.	0.	Initial load. Loaded with 6,000 pounds before testing.
12,620	150	.0007	0.	
16,826	200	.0015	.0002	
21,033	250	.0021	.0002	
25,239	300	.0029	.0003	
29,446	350	.0038	.0003	
33,652	400	.0047	.0005	
37,859	450	.0056	.0006	
42,065	500	.0067	.0009	
46,272	550	.0077	.0011	
50,478	600	.0089	.0013	E (100-600) = 3,289,000 pounds per square inch.
.....	600	.0089	.0014	
54,685	650	.0098	.0015	
58,891	700	.0109	.0017	
63,098	750	.0120	.0020	
67,304	800	.0133	.0023	
71,511	850	.0146	.0028	
75,717	900	.0156	.0031	
79,924	950	.0170	.0035	
84,130	1,000	.0183	.0040	E (600-1,000) = 2,985,000 pounds per square inch.
.....	600	.0123	.0039	
.....	600	.0124	.0040	

No. 1739—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
92,543	1,100	.0215	.0050	
100,956	1,200	.0245	.0063	
109,369	1,300	.0289	.0082	
117,782	1,400	.0331	.0103	Remained 17 hours under 16,000 pounds total load. Permanent set under initial load at end of this period, ".0100.
126,195	1,500	.0373	.0108	E (1,000–1,500)=2,451,000 pounds per square inch.
.....	600	.0223	.0128	
.....	600	.0223	.0128	
134,608	1,600	.0428	.0155	
143,021	1,700	.0476	.0179	
151,434	1,800	.0532	.0210	
159,847	1,900	.0600	.0253	Sharp, snapping sounds.
168,260	2,000	.0632	.0283	Sounding the hoops with a hammer blow shows different tensions with column under 2,000 pounds per square inch. E (1,500–2,000)=2,404,000 pounds per square inch.
.....	600	.0397	.0283	
.....	600	.0397	.0282	
176,673	2,100	.0729	.0327	
185,086	2,200	.0798	.0365	
193,499	2,300	.0880	.0413	
201,912	2,400	.0955	.0462	
210,325	2,500	.1050	.0526	E (2,000–2,500)=1,429,000 pounds per square inch.
.....	600	.0657	.0524	
.....	600	.0648	.0519	
218,738	2,600	.1125	.0571	
227,151	2,700	.1218	.0626	
235,564	2,800	.1294	.0681	
243,977	2,900	.1394	.0748	
252,390	3,000	.1473	.0794	E (2,500–3,000)=1,613,000 pounds per square inch.
.....	600	.0939	.0787	
.....	600	.0938	.0788	
260,803	3,100	.1588	.0875	
269,216	3,200	.1719	.0969	
.....	600	.1117	.0900	
.....	600	.1111	.0958	Set after 5 minutes, ".0948.
.....	200	.0970	.....	
.....	400	.1033	.....	
.....	600	.1100	.....	
.....	800	.1160	.....	
.....	1,000	.1220	.....	
.....	800	.1187	.....	
.....	600	.1145	.....	
.....	400	.1082	.....	
.....	200	.0998	.0955	Micrometer removed.
336,520	4,000	.....	.....	Load applied and released to 100 pounds per square inch. The total height of the column under 100 pounds per square inch is now 95".90. Concrete generally cracked at edges of hoops.
.....	100	0.	0.	Micrometer replaced on original gauged length and reset at zero.
.....	600	.0178	.0004	
.....	600	.0173	.0009	
.....	200	.0039	.....	
.....	400	.0105	.....	
.....	600	.0168	.....	
.....	800	.0230	.....	
.....	1,000	.0295	.....	

No. 1739—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
.....	800	.0254	.....	
.....	600	.0218	.....	
.....	400	.0151	.....	
.....	200	.0072	.0023	
.....	600	.0175	.0019	
.....	600	.0178	.0019	
.....	600	.0176	.0016	Micrometer again removed.
445,000	5,289	.....	.....	Ultimate strength.

Column finally failed by triple flexure, yielding upward at middle of length. The load sustained gradually fell to 390,000 pounds as the distortion increased, at which time two hoops near the middle of the length of the column fractured across the line of rivet holes. The test was then discontinued. Reducing the load to 100 pounds per square inch, the deflection at middle was 1″.50. The total height of the column was now 95″.12, a total shortening of 1″.03.

No. 1739.

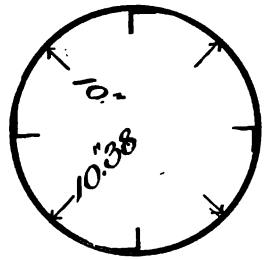
CONCRETE COLUMN, 1 : 2 : 4 MIXTURE, REËNFORCED WITH 8 [illegible] HOOPS.
APPEARANCE AFTER COMPLETION OF TEST.

CAMPBELL ART CO.
ELIZABETH N. J.

No. 1738.

1 : 2 : 4 Mixture.

Reënforced with 13 hoops, each 1″.50 wide by ″.12 thick, and four 1″×1″ by 95″.70 steel angle bars. Hoops spaced 8″ apart, center to center.



Composition, by volume: Alpha cement, 1; sand, 2; trap rock (¾″ to 1½″), 4. Water, 68 per cent of cement, by weight.

Age, set in air, 6 months 7 days.

Weight of column, total, 740 pounds.

Weight of concrete, 690 pounds = 150.7 pounds per cubic foot.

Weight of cage, complete, 50 pounds.

Height of column, 95.70 inches.

Diameter of column, 10.38 inches.

Sectional area, 84.62 square inches.

Sectional area of angle bars, 0.91 square inch.

Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
8,462	100	0.	0.	Initial load. Loaded with 8,000 pounds before testing.
12,693	150	.0010	0.	
16,924	200	.0021	.0002	
21,155	250	.0033	.0004	
25,386	300	.0045	.0007	
29,617	350	.0057	.0010	
33,848	400	.0070	.0011	
38,070	450	.0082	.0013	
42,310	500	.0093	.0016	
46,541	550	.0103	.0018	
50,772	600	.0113	.0018	E (100-600) = 2,632,000 pounds per square inch.
.....	600	.0113	.0019	
55,003	650	.0122	.0018	
59,234	700	.0134	.0020	
63,465	750	.0144	.0020	
67,696	800	.0155	.0021	
71,927	850	.0166	.0023	
76,158	900	.0179	.0024	
80,389	950	.0190	.0029	
84,620	1,000	.0205	.0032	E (600-1,000) = 2,564,000 pounds per square inch.
.....	600	.0141	.0031	
.....	600	.0141	.0031	
93,082	1,100	.0231	.0038	
101,544	1,200	.0261	.0045	
110,006	1,300	.0291	.0054	
118,468	1,400	.0326	.0073	
126,930	1,500	.0370	.0085	E (1,000-1,500) = 2,232,000 pounds per square inch.

No. 1738—Continued.

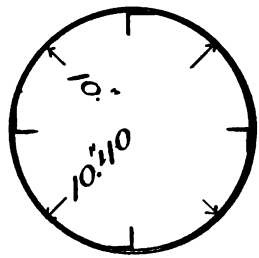
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
.....	600	.0221	.0087	
.....	600	.0223	.0088	
135,392	1,600	.0417	.0105	
143,854	1,700	.0469	.0106	
152,316	1,800	.0810	.0430	Contact point at one end of micrometer broke through wall of cavity in concrete.
160,778	1,900	.0884	.0462	
169,240	2,000	.0946	.0508	E (1,500–2,000)=1,634,000 pounds per square inch.
.....	100	0.	0.	Micrometer reset at zero on a new gauged length.
.....	600	.0198	.0001	
.....	600	.0198	.0002	
177,702	2,100	.0548	.0042	
186,164	2,200	.0630	.0094	
194,626	2,300	.0752	.0181	
203,088	2,400	.0865	.0270	
211,550	2,500	.1018	.0390	E (2,000–2,500)=1,316,000 pounds per square inch.
.....	600	.0580	.0385	
.....	600	.0576	.0384	
220,012	2,600	.1150	.0495	
228,474	2,700	.1330	.0640	
256,300	3,029	.....	.....	Ultimate strength.

Failure of the column occurred about 2 feet from the upper end. After passing the ultimate resistance, and while the sustaining power was gradually diminishing, the fourth hoop fractured, accompanied by a sudden loss in resistance of the concrete. Circular cracks developed at the hoops under the earliest loads, and increased in prominence as the test advanced.

No. 1692.

1 : 2 : 4 Mixture.

Reënforced with 25 cylindrical hoops 1″.50 wide by ″.12 thick each, spaced 4″ apart, center to center; four steel angle bars (1″ × ⅛″ legs) within the hoops and extending from end to end of column; hoops secured to angles by means of wire staples.



Composition, by volume: Alpha cement, 1; sand, 2; trap rock (¾″ to 1½″), 4. Water, 43.8 per cent of cement, by weight.

Surface not plastered.

Age, set in air, 15 days.

Weight of column, total, 731 pounds.

Weight of concrete, 659 pounds = 144.2 pounds per cubic foot.

Weight of cage, complete, 72 pounds.

Height of column, 95.95 inches.

Diameter of column, 10.40 inches; sectional area, gross, 84.95 square inches.

Sectional area of angle bars, 0.91 square inch.

Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
8,495	100	0.	0.	Initial load. Loaded with 5,000 pounds before testing.
12,743	150	.0010	.0001	
16,990	200	.0015	.0003	
21,238	250	.0021	.0005	
25,485	300	.0031	.0006	
29,733	350	.0041	.0007	
33,980	400	.0054	.0010	
38,228	450	.0064	.0011	
42,475	500	.0074	.0013	
46,723	550	.0085	.0018	
50,970	600	.0099	.0019	E (100-600) = 3,125,000 pounds per square inch.
.....	600	.0101	.0020	
59,465	700	.0125	.0024	
67,960	800	.0158	.0033	
76,455	900	.0200	.0044	
84,950	1,000	.0250	.0059	E (600-1,000) = 1,802,000 pounds per square inch.
.....	600	.0178	.0059	
.....	600	.0176	.0059	
93,445	1,100	.0311	.0077	
101,940	1,200	.0371	.0089	
110,435	1,300	.0440	.0109	
118,930	1,400	.0515	.0126	
127,425	1,500	.0584	.0141	E (1,000-1,500) = 992,000 pounds per square inch.

No. 1692—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
.....	600	.0360	.0139	
.....	600	.0358	.0141	
135,920	1,600	.0679	.0171	
144,415	1,700	.0781	.0222	
152,910	1,800	.0905	.0301	
.....	600	.0565	.0301	
.....	600	.0564	.0300	
.....	.....	.....	.0289	Set after rest of 40 minutes.
.....	200	.0331	.....	
.....	300	.0397	.....	
.....	400	.0455	.....	
.....	500	.0504	.....	
.....	600	.0546	.....	
.....	500	.0525	.....	
.....	400	.0490	.....	
.....	300	.0440	.....	
.....	200	.0371	.0299	
161,405	1,900	.1043	.0406	
169,900	2,000	.1270	.0603	E (1,500–2,000)=1,116,000 pounds per square inch.
.....	600	.0860	.0604	
.....	600	.0854	.0604	
178,395	2,100	.1485	.0790	
186,890	2,200	.1704	.0984	
.....	600	.1219	.0984	
.....	600	.1215	.0988	
195,385	2,300	.2030	.1260	
.....	600	.1485	.1261	
.....	600	.1484	.1260	
.....	.....	.....	.1258	Set after rest of 10 minutes.
.....	200	.1291	.....	
.....	300	.1339	.....	
.....	400	.1389	.....	
.....	500	.1444	.....	
.....	600	.1477	.....	
.....	700	.1517	.....	
.....	800	.1559	.....	
.....	900	.1596	.....	
.....	1,000	.1635	.....	
.....	900	.1622	.....	
.....	800	.1603	.....	
.....	700	.1580	.....	
.....	600	.1549	.....	
.....	500	.1514	.....	
.....	400	.1471	.....	
.....	300	.1417	.....	
.....	200	.1350	.1280	
260,400	3,065	.....	.....	Ultimate strength.

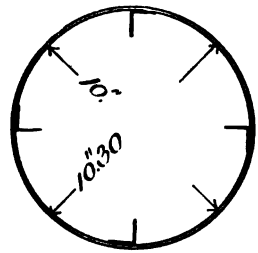
Column failed by triple flexure. Test discontinued when column had deflected 1″.8 at middle of its length. The column was then yielding slowly under a total load of 220,000 pounds. The angle bars buckled between hoops along middle of height of column and near the upper end on the compression sides of the bends. One hoop located near middle of height of column was fractured across first rivet hole.

CAMPBELL ART CO.
ELIZABETH, N. J.

No. 1726.

1 : 2 : 4 Mixture.

Reënforced with 25 hoops, each 1″.50 wide by ″.12 thick, and four 1″×1″ by 95″.90 steel angle bars. Hoops spaced 4″ center to center.



Composition, by volume: Alpha cement, 1; sand, 2; trap rock (¾″ to 1½″), 4. Water, 39.7 per cent of cement, by weight.

Age, set in air, 5 months 12 days.

Weight of column, total, 747 pounds.

Weight of concrete, 675 pounds = 150.7 pounds per cubic foot.

Weight of cage, complete, 72 pounds.

Height of column, 95.90 inches.

Diameter of column, 10.30 inches.

Sectional area, gross, 83.32 square inches.

Sectional area of angle bars, 0.91 square inch.

Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
8,332	100	0.	0.	Initial load. Loaded with 0.00 pounds before testing.
12,498	150	.0010	0.	
16,664	200	.0021	.0004	
20,830	250	.0035	.0005	
24,996	300	.0047	.0008	
29,162	350	.0062	.0010	
33,328	400	.0075	.0013	
37,494	450	.0090	.0015	
41,660	500	.0107	.0017	
45,826	550	.0117	.0019	
49,992	600	.0130	.0021	E (100–600) = 2,294,000 pounds per square inch.
.....	600	.0134	.0024	
54,158	650	.0145	.0026	
58,324	700	.0159	.0030	
62,490	750	.0174	.0029	
66,656	800	.0188	.0031	
70,822	850	.0203	.0036	
74,988	900	.0218	.0040	
79,154	950	.0233	.0042	
83,320	1,000	.0246	.0045	E (600–1,000) = 2,174,000 pounds per square inch.
.....	600	.0178	.0046	
.....	600	.0178	.0047	
91,652	1,100	.0279	.0049	
99,984	1,200	.0313	.0058	
108,316	1,300	.0359	.0066	
116,648	1,400	.0394	.0074	
124,980	1,500	.0436	.0085	E (1,000–1,500) = 1,667,000 pounds per square inch.
.....	600	.0264	.0083	
.....	600	.0263	.0082	

No. 1726—Continued.

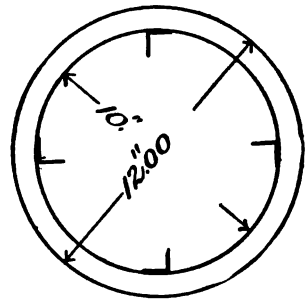
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
133,312	1,600	.0483	.0093	
141,644	1,700	.0535	.0103	Rested under initial load 30 minutes.
149,976	1,800	.0607	.0129	
158,308	1,900	.0655	.0146	
166,640	2,000	.0715	.0173	E (1,500–2,000)=1,309,000 pounds per square inch.
.....	600	.0414	.0172	
.....	600	.0412	.0172	
174,972	2,100	.0790	.0221	
183,304	2,200	.0881	.0291	
191,636	2,300	.0972	.0364	
199,968	2,400	.1050	.0427	
208,300	2,500	.1164	.0524	E (2,000–2,500)=2,551,000 pounds per square inch.
.....	600	.0735	.0525	
.....	600	.0731	.0524	
216,632	2,600	.1288	.0621	
224,964	2,700	.1410	.0720	
.....	600	.0915	.0719	
.....	600	.0913	.0719	
233,296	2,800	.1522	.0813	
.....	600	.1005	.0812	
.....	600	.1002	.0814	
241,628	2,900	.1644	.0913	
249,960	3,000	.1755	.1006	E (2,500–3,000)=2,294,000 pounds per square inch.
.....	600	.1190	.1006	
.....	600	.1185	.1002	
258,292	3,100	.1937	.1158	
.....	600	.1333	.1156	
.....	600	.1330	.1155	
349,000	4,189	.....	.....	Ultimate strength.

Concrete flaked off at the unsupported sections between hoops. Flaking off began about when the load on the column reached 3,000 pounds per square inch, and continued thereafter. Ultimate failure occurred by reason of lateral deflection of the column, at the middle of its height, developing triple flexure.

No. 1728.

1:2:4 Mixture.

Reënforced with 25 hoops, each 1″.50 wide by ″.12 thick, and four 1″×1″ by 96″ steel angle bars. Hoops spaced 4″ apart, center to center.



Composition, by volume: Alpha cement, 1; sand, 2; trap rock (¾″ to 1½″), 4. Water, 45.4 per cent of cement, by weight.

Age, set in air, 5 months 12 days.

Weight of column, total, 990 pounds.

Weight of concrete, 917.5 pounds = 149.4 pounds per cubic foot.

Weight of cage, complete, 72½ pounds.

Height of column, 96 inches.

Diameter of column, 12 inches.

Sectional area, gross, 113.10 square inches.

Sectional area of angle bars, 0.91 square inch.

Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
11,310	100	0.	0.	Initial load. Loaded with 9,000 pounds before testing.
16,965	150	.0010	0.	
22,620	200	.0023	.0004	
28,275	250	.0034	.0005	
33,930	300	.0046	.0008	
39,585	350	.0060	.0010	
45,240	400	.0074	.0013	
50,895	450	.0086	.0015	
56,550	500	.0100	.0019	
62,205	550	.0114	.0021	
67,860	600	.0131	.0030	E (100–600) = 2,475,000 pounds per square inch.
.....	600	.0134	.0030	
73,515	650	.0145	.0030	
79,170	700	.0157	.0032	
84,825	750	.0174	.0038	
90,480	800	.0189	.0040	
96,135	850	.0204	.0045	
101,790	900	.0224	.0050	
107,445	950	.0243	.0054	
113,100	1,000	.0264	.0060	E (600–1,000) = 1,942,000 pounds per square inch.
.....	600	.0190	.0060	
.....	600	.0189	.0060	
124,410	1,100	.0296	.0070	
135,720	1,200	.0342	.0081	
147,030	1,300	.0385	.0092	

No. 1728—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
158,340	1,400	.0431	.0101	
169,650	1,500	.0494	.0122	E (1,000-1,500)=1,488,000 pounds per square inch.
.....	600	.0306	.0120	
.....	600	.0306	.0120	
180,960	1,600	.0545	.0131	
192,270	1,700	.0604	.0155	
203,580	1,800	.0668	.0187	
214,890	1,900	.0745	.0231	
226,200	2,000	.0849	.0294	E (1,500-2,000)=1,366,000 pounds per square inch.
.....	600	.0524	.0294	
.....	600	.0521	.0293	
237,510	2,100	.0940	.0360	Snapping sound.
248,820	2,200	.1082	.0469	
260,130	2,300	.1200	.0562	Two short cracks appear on surface of column, near middle, nearly circular in direction; also circular and oblique cracks near end of column.
271,440	2,400	.1350	.0674	
282,750	2,500	.1490	.0785	E (2,000-2,500)=1,667,000 pounds per square inch.
.....	600	.0997	.0784	
.....	600	.0995	.0783	
294,060	2,600	.1650	.0907	
305,370	2,700	.1845	.1073	
.....	600	.1279	.1072	
.....	600	.1277	.1071	
316,680	2,800	.2006	.1204	
327,990	2,900	.2240	.1404	
339,300	3,000	.2450	.1591	E (2,500-3,000)=1,623,000 pounds per square inch.
.....	600	.1786	.1589	
.....	600	.1781	.1588	
370,000	3,271	.....	.....	Ultimate strength.

Cracks continued to develop—circular, longitudinal, and oblique—as the loads were advanced from 2,300 pounds per square inch. After passing the maximum stress, and while the loads were gradually dropping, the fourth hoop from the upper end of the column fractured across the first rivet hole. The outer shell opened wide cracks in the upper part of the column, one section of which is shown by the accompanying photograph.

NO. 1 - 28.

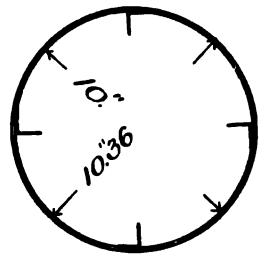
CONCRETE COLUMN, 1 : 2 : 4 MIXTURE, REENFORCED WITH HOOPS AND ANGLE BARS. OUTER SHELL OF CONCRETE 1 IN. THICK.
APPEARANCE AFTER COMPLETION OF TEST.

CAMPBELL ART CO.

No. 1746.

1 : 2 : 4 Mixture.

Reënforced with 48 hoops, each 1″.04 wide by ″.06 thick, and four 1″×1″ by 95″.50 steel angle bars. Hoops spaced 2″ apart, center to center.



Composition, by volume: Alpha cement, 1; sand, 2; trap rock (¼″ to ¾″), 4. Water, 79.4 per cent of cement, by weight.
Age, set in air, 5 months 12 days.
Weight of column, total, 728 pounds.
Weight of concrete, 667 pounds = 147.2 pounds per cubic foot.
Weight of cage, complete, 61 pounds.
Height of column, 95.50 inches.
Diameter of column, 10.36 inches.
Sectional area, gross, 84.30 square inches.
Sectional area of angle bars, 0.91 square inch.
Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
8,430	100	0.	0.	Initial load. Loaded with 9.000 pounds before testing.
12,645	150	.0008	.0002	
16,860	200	.0014	.0003	
21,075	250	.0023	.0005	
25,290	300	.0029	.0006	
29,505	350	.0037	.0006	
33,720	400	.0044	.0008	
37,935	450	.0053	.0009	
42,150	500	.0062	.0010	
46,365	550	.0071	.0012	
50,580	600	.0080	.0013	E (100-600) = 3,731,000 pounds per square inch.
.....	600	.0082	.0014	
54,795	650	.0089	.0016	
59,010	700	.0098	.0017	
63,225	750	.0107	.0019	
67,440	800	.0117	.0021	
71,655	850	.0127	.0022	
75,870	900	.0135	.0022	
80,085	950	.0145	.0023	
84,300	1,000	.0155	.0026	E (600-1,000) = 3,226,000 pounds per square inch.
.....	600	.0099	.0026	
.....	600	.0098	.0026	
92,730	1,100	.0175	.0029	
101,160	1,200	.0193	.0033	
109,590	1,300	.0214	.0037	
118,020	1,400	.0238	.0041	

No. 1746—Continued.

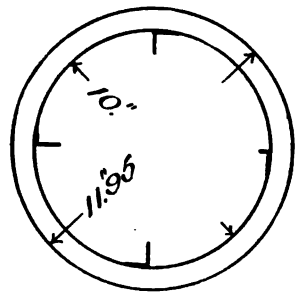
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
126,450	1,500	.0260	.0045	E (1,000-1,500)=2,907,000 pounds per square inch.
.....	600	.0128	.0044	
.....	600	.0127	.0044	
134,880	1,600	.0288	.0052	
143,310	1,700	.0313	.0055	
151,740	1,800	.0340	.0061	
160,170	1,900	.0368	.0068	
168,600	2,000	.0395	.0072	E (1,500-2,000)=2,315,000 pounds per square inch.
.....	600	.0171	.0071	
.....	600	.0170	.0071	
177,030	2,100	.0428	.0080	
185,460	2,200	.0466	.0092	
193,890	2,300	.0510	.0105	
202,320	2,400	.0556	.0121	
210,750	2,500	.0627	.0151	E (2,000-2,500)=1,634,000 pounds per square inch.
.....	600	.0279	.0149	
.....	600	.0281	.0147	
219,180	2,600	.0670	.0163	
227,610	2,700	.0724	.0187	
236,040	2,800	.0785	.0216	
244,470	2,900	.0853	.0255	
252,900	3,000	.0934	.0309	E (2,500-3,000)=1,678,000 pounds per square inch.
.....	600	.0457	.0306	
.....	600	.0452	.0305	
261,330	3,100	.1028	.0366	
269,760	3,200	.1140	.0444	Small cracks at different places.
278,190	3,300	.1255	.0530	
286,620	3,400	.1368	.0612	
295,050	3,500	.1493	.0709	E (3,000-3,500)=1,572,000 pounds per square inch.
.....	600	.0854	.0702	
.....	600	.0845	.0702	
303,480	3,600	.1620	.0814	
311,910	3,700	.1772	.0930	
320,340	3,800	.1980	.1113	
.....	600	.1247	.1108	
.....	600	.1240	.1103	
324,000	3,843	.....	.....	Ultimate strength.

Opened cracks generally along the height of the column. The principal zone of rupture was one foot from the lower end. Two hoops fractured, 9″ and 11″ from the lower end, after passing the maximum stress.

No. 1744.

1:2:4 Mixture.

Reënforced with 48 hoops, each 1″.04 wide by ″.06 thick, and four 1″ × 1″ by 95″.62 steel angle bars. Hoops spaced 2″ apart, center to center.



Composition, by volume: Alpha cement, 1; sand, 2; trap rock (¼″ to ¾″), 4. Water, 72.6 per cent of cement, by weight.

Age, set in air, 6 months.

Weight of column, total, 962 pounds.

Weight of concrete, 901 pounds = 148.2 pounds per cubic foot.

Weight of cage, complete, 61 pounds.

Height of column, 95.62 inches.

Diameter of column, 11.95 inches.

Sectional area, gross, 112.16 inches.

Sectional area of angle bars, 0.91 square inch.

Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
11,216	100	0.	0.	Initial load. Loaded with 9,000 pounds before testing.
16,824	150	.0009	.0003	
22,432	200	.0019	.0003	
28,040	250	.0030	.0005	
33,648	300	.0040	.0007	
39,256	350	.0051	.0009	
44,864	400	.0066	.0011	
50,472	450	.0079	.0013	
56,080	500	.0032	.0015	
61,688	550	.0107	.0019	
67,296	600	.0123	.0023	E (100-600) = 2,500,000 pounds per square inch.
.....	600	.0124	.0023	
72,904	650	.0136	.0026	
78,512	700	.0150	.0027	
84,120	750	.0167	.0033	
89,728	800	.0180	.0035	
95,336	850	.0194	.0039	
100,944	900	.0215	.0043	
106,552	950	.0230	.0049	
112,160	1,000	.0249	.0051	E (600-1,000) = 2,041,000 pounds per square inch.
.....	600	.0172	.0053	
.....	600	.0172	.0053	
123,376	1,100	.0281	.0060	
134,592	1,200	.0318	.0069	
145,808	1,300	.0361	.0081	

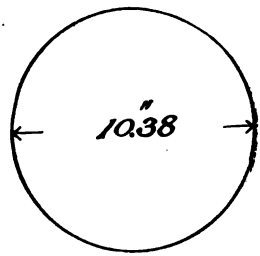
No. 1744—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
157,024	1,400	.0407	.0092	
168,240	1,500	.0457	.0105	E (1,000–1,500) = 1,634,000 pounds per square inch.
.....	600	.0265	.0106	
.....	600	.0261	.0103	
179,456	1,600	.0510	.0118	
190,672	1,700	.0568	.0134	
201,888	1,800	.0629	.0158	Rested under 150 pounds per square inch 18 hours. Set at end of rest, ".0148.
213,104	1,900	.0695	.0190	
224,320	2,000	.0780	.0242	E (1,500–2,000) = 1,337,000 pounds per square inch.
.....	600	.0442	.0241	
.....	600	.0441	.0241	
235,536	2,100	.0892	.0320	
246,752	2,200	.1013	.0409	
257,968	2,300	.1126	.0540	
269,184	2,400	.1279	.0609	Crack opened near middle of height of column.
280,400	2,500	.1454	.0751	E (2,000–2,500) = 1,515,000 pounds per square inch.
.....	600	.0944	.0750	
.....	600	.0938	.0747	
291,616	2,600	.1634	.0890	
302,832	2,700	.1848	.1069	
314,048	2,800	.2040	.1220	
.....	600	.1411	.1219	
.....	600	.1407	.1218	
335,200	2,989	.....	.....	Ultimate strength.

Opened oblique cracks in a section 2 feet long, from middle of height of column to within 2 feet of upper end. The load gradually fell to 320,000 pounds, when a hoop near the middle of height of column fractured, at which time a sudden drop in resistance occurred.

No. 1732.

1:3:6 Mixture.
Plain column, without reënforcing metal.



Composition, by volume: Alpha cement, 1; sand, 3; trap rock ($\frac{3}{4}$" to 1$\frac{1}{2}$"), 6. Water, 90.7 per cent of cement, by weight.
Age, set in air, 5 months 11 days.
Weight of column, total, 698 pounds.
Weight of concrete, 698 pounds = 148.2 pounds per cubic foot.
Height of column, 96.10 inches.
Diameter of column, 10.38 inches.
Sectional area, 84.62 square inches.
Gauged length, 50".

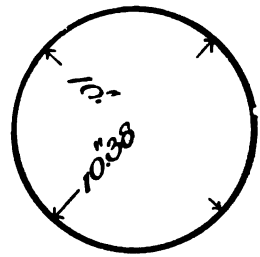
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
8,462	100	0.	0.	Initial load. Loaded with 6,000 pounds before testing.
12,693	150	.0011	0.	
16,924	200	.0024	.0003	
21,155	250	.0038	.0006	
25,386	300	.0064	.0010	
29,617	350	.0072	.0017	
33,848	400	.0090	.0023	
38,079	450	.0110	.0031	
42,310	500	.0134	.0039	
46,541	550	.0152	.0049	
50,772	600	.0179	.0060	E (100-600) = 2,101,000 pounds per square inch.
.....	600	.0185	.0065	
55,003	650	.0207	.0075	
59,234	700	.0238	.0093	
63,465	750	.0286	.0121	Ultimate strength.

Column failed near its lower end, opening oblique and longitudinal cracks. The maximum load was applied and released; upon reapplying a load failure was completed under diminished stress. The lower end of the column was less sound than the upper part, due to leakage of the mold in which it was formed.

No. 1742.

1:3:6 Mixture.

Reënforced with 25 hoops, each 1″.50 wide by ″.12 thick. Hoops spaced 4″ apart, center to center.



Composition, by volume: Alpha cement, 1; sand, 3; trap rock (¾″ to 1½″), 6. Water, 83.2 per cent of cement, by weight.

Age, set in air, 6 months 4 days.

Weight of column, total, 721 pounds.

Weight of concrete, 674 pounds = 145.9 pounds per cubic foot.

Weight of hoops, 47 pounds.

Height of column, 96.25 inches.

Diameter of column, 10.38 inches.

Sectional area, gross, 84.62 square inches.

Gauged length, 50″.

Defective column; a hoop 2 feet from lower end was displaced during construction.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
8,462	100	0.	0.	Initial load. Loaded with 8,000 pounds before testing.
12,693	150	.0015	.0005	
16,924	200	.0034	.0014	
21,155	250	.0056	.0031	
25,386	300	.0083	.0033	
29,617	350	.0110	.0048	
33,848	400	.0145	.0067	
38,079	450	.0181	.0089	
42,310	500	.0219	.0110	
46,541	550	.0262	.0135	
50,772	600	.0318	.0174	E (100-600) = 1,736,000 pounds per square inch.
.....	600	.0329	.0182	
.....	600	.0342	.0191	
.....	600	.0368	.0226	Rested under 600 pounds per square inch 30 minutes.
.....	600	.0371	.0228	
.....	600	.0374	.0229	
.....	600	.0376	.0229	Rested under initial load 20 hours. Set at end of rest, ″.0221.
.....	600	.0370	.0224	
55,003	650	.0392	.0232	
59,234	700	.0426	.0248	
63,465	750	.0498	.0300	
67,696	800	.0556	.0334	
71,927	850	.0625	.0382	
76,158	900	.0707	.0440	
80,389	950	.0795	.0503	
84,620	1,000	.0886	.0570	E (600-1,000) = 1,163,000 pounds per square inch.
.....	600	.0763	.0571	
.....	600	.0761	.0572	

No. 1742—Continued.

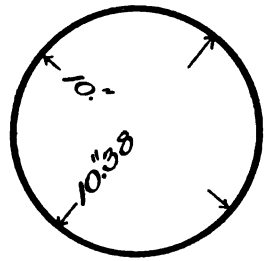
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
93,082	1,100	.1050	.0687	
101,544	1,200	.1230	.0819	
110,006	1,300	.1446	.0980	
118,468	1,400	.1660	.1136	
126,930	1,500	.1890	.1305	E (1,000-1,500) = 929,000 pounds per square inch.
.....	600	.1564	.1310	
.....	600	.1556	.1308	
162,300	1,918	.....	.....	Ultimate strength.

Column failed 2 feet from lower end, where a hoop was displaced during construction; this hoop was in an oblique position. The behavior of the column under the successive loads, as indicated by the micrometer observations of compressions and sets, is believed to be reliably shown. The defective part was outside the gauged length. The ultimate strength, however, was reduced by reason of the defective hoop.

No. 1743.

1 : 3 : 6 Mixture.

Reënforced with 25 hoops, each 1″.50 wide by ″.12 thick. Hoops spaced 4″ apart, center to center.



Composition, by volume: Alpha cement, 1; sand, 3; cinders, 6. Water, 105.8 per cent of cement, by weight.

Age, set in air, 6 months 4 days.

Weight of column, total, 515 pounds.

Weight of concrete, 468 pounds = 101.3 pounds per cubic foot.

Weight of hoops, 47 pounds.

Height of column, 96.30 inches.

Diameter of column, 10.38 inches.

Sectional area, 84.62 square inches.

Gauged length, 50″.

The hoops were generally without initial tension, appearing slightly loose when "sounded" with a hammer blow.

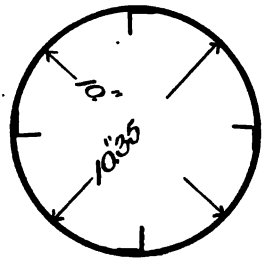
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
8,462	100	0.	0.	Initial load. Loaded with 7,000 pounds before testing.
12,693	150	.0039	.0013	
16,924	200	.0084	.0030	
21,155	250	.0131	.0050	
25,386	300	.0186	.0069	
29,617	350	.0242	.0092	
33,848	400	.0305	.0120	
38,079	450	.0378	.0152	
42,310	500	.0450	.0190	
46,541	550	.0543	.0238	
50,772	600	.0649	.0293	E (100–600) = 702,000 pounds per square inch.
.....	600	.0679	.0319	
55,003	650	.0773	.0370	
59,234	700	.0891	.0445	
63,465	750	.1037	.0527	
67,696	800	.1175	.0605	
71,927	850	.1336	.0691	
.....	600	.1162	.0697	
.....	600	.1162	.0701	
76,158	900.	.1565	.0836	
80,389	950	.1783	.0958	
84,620	1,000	.2000	.1075	E (600–1,000) = 351,000 pounds per square inch.
.....	600	.1668	.1081	
.....	600	.1666	.1084	
96,000	1,134	.....	.....	Ultimate strength.

Column failed 18″ from the lower end. There was porous concrete in the vicinity of the fracture. Detached portions flaked off between the hoops.

No. 1727.

1:3:6 Mixture.

Reënforced with 25 hoops, each 1″.50 wide by ″.12 thick, and four 1″×1″ by 96″ steel angle bars. Hoops spaced 4″ center to center. Hoop metal lapped and riveted with 3 rivets.



Composition, by volume: Alpha cement, 1; sand, 3; trap rock (¾″ to 1½″), 6. Water, 60.3 per cent of cement, by weight.

Age, set in air, 5 months 11 days.

Weight of column, total, 744 pounds.

Weight of concrete, 672 pounds = 148.3 pounds per cubic foot.

Weight of cage, complete, 72 pounds.

Height of column, 96 inches.

Diameter of column, 10.35 inches.

Sectional area, gross, 84.13 square inches.

Sectional area of angle bars, 0.91 square inch.

Gauged length, 50″.

This column had porous spots in it, which were filled with cement mortar when removed from the mold.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
8,413	100	0.	0.	Initial load. Loaded with 8,000 pounds before testing.
12,620	150	.0017	.0003	
16,826	200	.0030	.0006	
21,033	250	.0049	.0013	
25,239	300	.0065	.0015	
29,446	350	.0080	.0019	
33,652	400	.0096	.0021	
37,859	450	.0113	.0025	
42,065	500	.0129	.0029	
46,272	550	.0144	.0032	
50,478	600	.0158	.0035	E (100–600) = 2,033,000 pounds per square inch.
.....	600	.0160	.0038	
54,685	650	.0175	.0039	
58,890	700	.0190	.0040	
63,098	750	.0205	.0044	
67,304	800	.0222	.0049	
71,511	850	.0240	.0054	
75,717	900	.0258	.0056	
79,924	950	.0276	.0060	
84,130	1,000	.0294	.0065	E (600–1,000) = 1,887,000 pounds per square inch.
.....	600	.0219	.0064	
.....	600	.0218	.0064	

No. 1727—Continued.

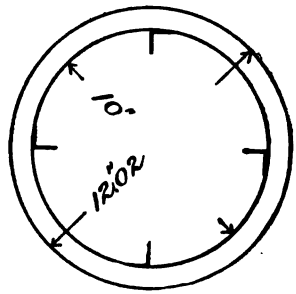
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
92,543	1,100	.0329	.0075	
100,956	1,200	.0367	.0083	
109,369	1,300	.0400	.0090	
117,782	1,400	.0451	.0099	
126,195	1,500	.0509	.0118	E (1,000-1,500)=1,543,000 pounds per square inch.
.....	600	.0319	.0115	
.....	600	.0319	.0116	
134,608	1,600	.0559	.0125	
143,021	1,700	.0606	.0141	
151,434	1,800	.0660	.0163	
159,847	1,900	.0729	.0200	
168,260	2,000	.0798	.0241	E (1,500-2,000)=1,506,000 pounds per square inch.
.....	600	.0481	.0241	
.....	600	.0480	.0241	
176,673	2,100	.0881	.0304	
185,086	2,200	.0971	.0370	
193,499	2,300	.1054	.0435	
201,912	2,400	.1150	.0513	
210,325	2,500	.1255	.0600	E (2,000-2,500)=2,551,000 pounds per square inch. Crack in concrete near lower end.
.....	600	.0805	.0599	Rested under initial load 30 minutes, at the end of which period the set was ".0588.
.....	600	.0787	.0591	
218,738	2,600	.1385	.0714	
227,151	2,700	.1513	.0808	
235,564	2,800	.1631	.0905	
243,977	2,900	.1730	.0976	
252,390	3,000	.1869	.1090	E (2,500-3,000)=2,016,000 pounds per square inch.
.....	600	.1270	.1088	
.....	600	.1265	.1086	
260,813	3,100	.1993	.1204	
269,216	3,200	.2110	.1297	
.....	600	.1463	.1293	
.....	600	.1466	.1297	
277,629	3,300	.2248	.1408	
.....	600	.1578	.1403	
.....	600	.1578	.1403	
286,042	3,400	.2426	.1569	
.....	600	.1741	.1570	Rested under initial load 30 minutes.
294,455	3,500	.2510	.1635	E (3,000-3,500)=2,604 000 pounds per square inch.
.....	600	.1800	.1629	
325,000	3,863	.....	.....	Ultimate strength.

Concrete cracked and flaked off at different places along the height of the column, but in a more marked degree near the lower end. After reaching the ultimate strength the loads were continued, gradually dropping. Further deformation took place, and the fifth hoop fractured across a rivet hole.

No. 1729.

1:3:6 Mixture.

Reënforced with 25 hoops, each 1″.50 wide by ″.12 thick, and four 1″×1″ by 96″ steel angle bars. Hoops spaced 4″ apart, center to center.



Composition, by volume: Alpha cement, 1; sand, 3; trap rock (¾″ to 1½″), 6. Water, 90.7 per cent of cement, by weight.

Age, set in air, 5 months 3 days.

Weight of column, total, 963 pounds.

Weight of concrete, 891 pounds = 144.6 pounds per cubic foot.

Weight of cage, complete, 72 pounds.

Height of column, 96 inches.

Diameter of column, 12.02 inches.

Sectional area, gross, 113.47 square inches.

Sectional area of angle bars, 0.91 square inch.

Gauged length, 50″.

Column contained many voids. Surface voids filled with a 1:3 mortar when column was taken out of mold.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
11,347	100	0.	0.	Initial load. Loaded with 8,000 pounds before testing.
17,021	150	.0030	.0014	
22,694	200	.0059	.0023	
28,368	250	.0084	.0030	
34,041	300	.0108	.0036	
39,715	350	.0133	.0041	
45,388	400	.0157	.0048	
51,062	450	.0181	.0051	
56,735	500	.0208	.0058	
62,409	550	.0234	.0063	
68,082	600	.0262	.0068	E (100–600) = 1,289,000 pounds per square inch.
.....	600	.0268	.0070	
73,756	650	.0290	.0073	
79,429	700	.0320	.0078	
85,103	750	.0350	.0085	
90,776	800	.0381	.0090	
96,450	850	.0410	.0095	
102,123	900	.0445	.0105	
107,797	950	.0484	.0117	
113,470	1,000	.0513	.0124	E (600–1,000) = 1,026,000 pounds per square inch.
.....	600	.0401	.0125	
.....	600	.0400	.0124	

No. 1729—Continued.

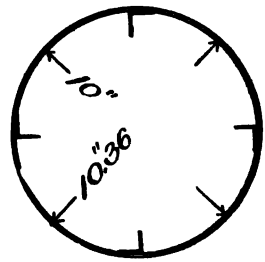
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
124,817	1,100	.0598	.0163	
136,164	1,200	.0683	.0221	
147,511	1,300	.0793	.0292	
158,858	1,400	.0935	.0398	Cracks appear in upper half of column.
170,205	1,500	.1100	.0527	E (1,000–1,500)=1,359,000 pounds per square inch.
.....	600	.0806	.0524	
.....	600	.0805	.0522	
181,552	1,600	.1265	.0662	
192,899	1,700	.1454	.0819	
204,246	1,800	.1645	.0975	Rested under initial load 16 hours. Set at end of rest, ".0969.
.....	600	.1229	.0972	
.....	600	.1229	.0976	
215,593	1,900	.1830	.1131	
299,000	2,634	.....	.....	Ultimate strength.

The principal cracks in the concrete, outside of the hooping, occurred in a section about 3 feet long and located 1 foot below the upper end of the column. Cracks gradually developed above loads of 1,400 pounds per square inch. After passing the maximum stress, the load slowly fell to about 280,000 pounds total, when the seventh hoop from the upper end of the column fractured across the first rivet hole. The total height of the column at this time was 95″.20, an upsetting of ″.80. A sudden loss in resistance followed the fracture of this hoop.

No. 1747.

1 : 3 : 6 Mixture.

Reënforced with 48 hoops, each 1″.06 wide by ″.6 thick, and four 1″×1″ by 95″.80 steel angle bars. Hoops spaced 2″ apart, center to center.



Composition, by volume: Alpha cement, 1; sand, 3; trap rock ($\frac{1}{4}$″ to $\frac{3}{4}$″), 6. Water, 105.8 per cent of cement by weight.

Age, set in air, 5 months 11 days.

Weight of column, total, 693 pounds.

Weight of concrete, 632 pounds = 138.9 pounds per cubic foot.

Weight of cage, complete, 61 pounds.

Height of column, 95.80 inches.

Diameter of column, 10.36 inches.

Sectional area, gross, 84.30 square inches.

Sectional area of angle bars, 0.91 square inch.

Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
8,430	100	0.	0.	Initial load. Loaded with 9,000 pounds before testing.
12,645	150	.0031	.0007	
16,860	200	.0065	.0015	
21,075	250	.0095	.0021	
25,290	300	.0124	.0028	
29,505	350	.0151	.0033	
33,720	400	.0178	.0038	
37,935	450	.0204	.0041	
42,150	500	.0233	.0046	
46,365	550	.0262	.0048	
50,580	600	.0291	.0052	E (100–600)=1,046,000 pounds per square inch.
.....	600	.0296	.0055	
54,795	650	.0323	.0056	
59,010	700	.0356	.0060	
63,225	750	.0385	.0065	
67,440	800	.0417	.0068	
71,655	850	.0453	.0075	
75,870	900	.0490	.0079	
80,085	950	.0530	.0088	
84,300	1,000	.0571	.0097	E (600–1,000)=851,000 pounds per square inch.
.....	600	.0435	.0097	
.....	600	.0432	.0096	
92,730	1,100	.0657	.0119	
101,160	1,200	.0776	.0181	
109,590	1,300	.0900	.0273	
118,020	1,400	.1047	.0404	
126,450	1,500	.1240	.0575	E (1,000–1,500)=1,309,000 pounds per square inch.

No. 1747—Continued.

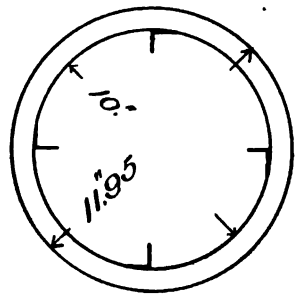
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
.....	600	.0898	.0576	
.....	600	.0896	.0576	
134,880	1,600	.1435	.0746	
143,310	1,700	.1646	.0930	
151,740	1,800	.1860	.1120	
.....	600	.1400	.1120	
.....	600	.1399	.1120	
160,170	1,900	.2075	.1309	
168,600	2,000	.2283	.1486	E (1,500-2,000)=1,894,000 pounds per square inch.
.....	600	.1749	.1487	
.....	600	.1748	.1487	
177,030	2,100	.2504	.1680	
185,460	2,200	.2698	.1852	
193,890	2,300	.2855	.1987	
.....	600	.2218	.1981	
.....	600	.2219	.1983	
212,000	2,515	.....	.....	Ultimate strength.

Column failed by triple flexure. Deflected upward and in part horizontally at the middle of its height. Two hoops were fractured near middle of height.

No. 1745.

1 : 3 : 6 Mixture.

Reënforced with 48 hoops, each 1″.04 wide by ″.06 thick, and four 1″×1″ by 96″ steel angle bars. Hoops spaced 2″ apart, center to center.



Composition, by volume: Alpha cement, 1; sand, 3; trap rock (¼″ to ¾″), 6. Water, 103.7 per cent of cement, by weight.

Age, set in air, 5 months 13 days.

Weight of column, total, 930 pounds.

Weight of concrete, 869 pounds = 142. 2 pounds per cubic foot.

Weight of cage, complete, 61 pounds.

Height of column, 96 inches.

Diameter of column, 11.95 inches.

Sectional area, gross, 112.16 square inches.

Sectional area of angle bars, 0.91 square inch.

Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
11,216	100	0.	0.	Initial load. Loaded with 7,500 pounds before testing.
16,824	150	.0027	.0009	
22,432	200	.0057	.0016	
28,040	250	.0081	.0021	
33,648	300	.0109	.0026	
39,256	350	.0134	.0033	
44,864	400	.0160	.0038	
50,472	450	.0185	.0044	
56,080	500	.0211	.0050	
61,688	550	.0239	.0056	
67,296	600	.0268	.0063	E (100-600)=1 220,000 pounds per square inch.
.....	600	.0272	.0065	
72,904	650	.0294	.0067	
78,512	700	.0320	.0075	
84,120	750	.0351	.0079	
89,728	800	.0381	.0086	
95,336	850	.0410	.0089	
100,944	900	.0447	.0098	
106,552	950	.0484	.0109	
112,160	1,000	.0514	.0118	E (600-1,000)=1,047,000 pounds per square inch.
.....	600	.0396	.0118	
.....	600	.0397	.0118	

No. 1745—Continued.

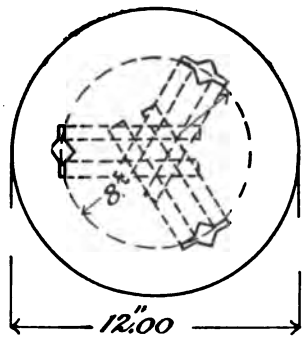
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
123,376	1,100	.0594	.0136	
134,592	1,200	.0681	.0170	
145,808	1,300	.0784	.0225	
157,024	1,400	.0891	.0296	
168,240	1,500	.1048	.0420	E (1,000–1,500)=1,078,000 pounds per square inch.
.....	600	.0730	.0416	
.....	600	.0729	.0417	
179,456	1,600	.1221	.0565	
190,672	1,700	.1385	.0700	Cracks opened.
201,888	1,800	.1575	.0850	
213,104	1,900	.1825	.1070	
224,320	2,000	.2055	.1259	E (1,500–2,000)=1,488,000 pounds per square inch.
.....	600	.1533	.1259	
.....	600	.1527	.1259	
235,536	2,100	.2345	.1510	
246,752	2,200	.2676	.1793	
259,000	2,309	.....	.....	Ultimate strength.

Failed 18 inches from the lower end of the column. Two hoops fractured 12 inches from the lower end when the resistance had fallen to about 240,000 pounds.

No. 1717.

1 : 2 : 4 Mixture.

Reënforced with 3 Kahn bars, each ″.76×″.76 by 95″.90 long, with prongs bent toward center of column at an angle of 45° to axis; bars embraced by one hoop of $\frac{3}{8}$″ wire, at lower end of column.



Composition, by volume: Alpha cement, 1; sand, 2; trap rock ($\frac{3}{4}$″), 4. Water, 79.4 per cent of cement, by weight.

Age, set in air, 5 months 8 days.

Weight of column, total, 959 pounds.

Weight of concrete, 894.25 pounds = 145.6 pounds per cubic foot.

Weight of Kahn bars and hoop, 64$\frac{3}{4}$ pounds.

Height of column, 95.90 inches.

Diameter of column, 12 inches.

Sectional area, gross, 113.10 square inches.

Sectional area of vertical bars, 1.73 square inches.

Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch*	*Inch*	
11,310	100	0	0.	Initial load. Loaded with 8,000 pounds before testing.
16,965	150	.0010	.0001	
22,620	200	.0021	.0003	
28,275	250	.0034	.0005	
33,930	300	.0044	.0006	
39,585	350	.0056	.0007	
45,240	400	.0066	.0009	
50,895	450	.0080	.0010	
56,550	500	0090	.0011	
62,205	550	0101	.0013	
67,860	600	.0114	.0014	E(100-600) = 2,500,000 pounds per square inch.
.....	600	.0116	.0015	
73,515	650	.0129	.0016	
79,170	700	.0140	.0018	
84,825	750	.0150	.0019	
90,480	800	.0166	.0021	
96,135	850	.0179	.0024	
101,790	900	.0191	.0027	
107,445	950	.0205	.0030	
113,100	1,000	.0220	.0032	E(600-1,000) = 2,273,000 pounds per square inch.
.....	600	.0146	.0030	
.....	600	.0143	.0030	

No. 1717—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
124,410	1,100	.0244	.0035	
135,720	1,200	.0271	.0039	
147,030	1,300	.0302	.0047	
158,340	1,400	.0334	.0055	
169,650	1,500	.0370	.0065	E(1,000-1,500)=2,137,000 pounds per square inch.
.....	600	.0195	.0065	
.....	600	.0195	.0064	
180,960	1,600	.0415	.0081	
192,270	1,700	.0470	.0102	
203,580	1,800	.0519	.0125	
214,890	1,900	.0606	.0182	
226,200	2,000	.0748	.0287	E(1,500-2,000)=1,603,000 pounds per square inch.
.....	600	.0437	.0285	
.....	600	.0433	.0283	
237,510	2,100	.1110	.....	Ultimate strength.

Opened oblique and longitudinal cracks along middle of height.

No. 1[illegible].

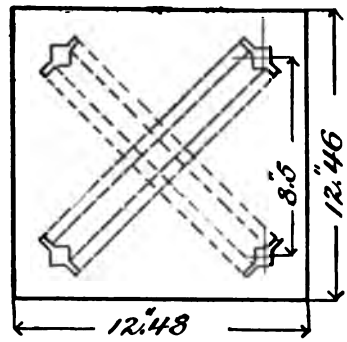
CONCRETE COLUMN, 1:2:4 MIXTURE, REINFORCED WITH 2 KAHN BARS IMBEDDED THEREIN.

APPEARANCE OF FRACTURED SECTION AFTER COMPLETION OF TEST.

No. 1711.

1 : 2 : 4 Mixture.

Reënforced with 4 Kahn bars, each ″.74×″.74 by 95″.95 long, with prongs bent toward center of column at an angle of 45° with axis.



Composition, by volume: Alpha cement, 1; sand, 2; trap rock ($\frac{3}{4}$″), 4. Water, 56.7 per cent of cement, by weight.

Age, set in air, 5 months 15 days.

Weight of column, total, 1,239 pounds.

Weight of concrete, 1,153 pounds = 136.3 pounds per cubic foot.

Weight of Kahn bars, 86 pounds.

Height of column, 95.95 inches.

Sectional area of column, gross, 12″.48×12″.46 = 155.50 square inches.

Sectional area of vertical bars, ″.74×″.74 = □″.5476×4 = 2.19 square inches.

Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
15,550	100	0.	0.	Initial load. Loaded with 12,000 pounds before testing.
23,325	150	.0010	0.	
31,100	200	.0020	0.	
38,875	250	.0031	0.	
46,650	300	.0041	.0001	
54,425	350	.0050	.0001	
62,200	400	.0061	.0002	
69,975	450	.0072	.0003	
77,750	500	.0084	.0005	
85,525	550	.0095	.0007	
93,300	600	.0108	.0008	E (100–600) = 2,500,000 pounds per square inch.
.....	600	.0109	.0009	
101,075	650	.0119	.0009	
108,850	700	.0130	.0010	
116,625	750	.0141	.0011	
124,400	800	.0155	.0012	
132,175	850	.0167	.0013	
139,950	900	.0180	.0015	
147.725	950	.0190	.0016	
155,500	1,000	.0204	.0017	E (600–1,000) = 2,299,000 pounds per square inch.
.....	600	.0132	.0018	
.....	600	.0133	.0019	

No. 1711—Continued.

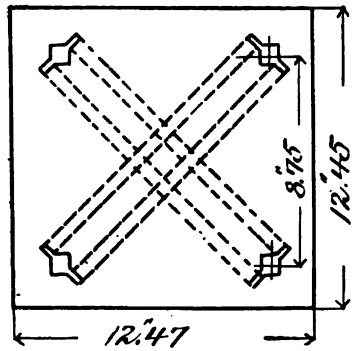
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
171,050	1,100	.0229	.0020	
186,600	1,200	.0255	.0025	
202,150	1,300	.0284	0030	
217,700	1,400	.0318	,0037	
233,250	1,500	.0348	.0041	E (1,000–1,500)=2,083,000 pounds per square inch.
.....	600	.0176	.0040	
.....	600	.0176	.0040	
248,800	1,600	.0396	.0051	
264,350	1,700	.0428	.0061	
279,900	1,800	.0470	.0078	
295,450	1,900	.0533	.0108	
311,000	2,000	.0615	.0161	E (1,500–2,000)=1,700,000 pounds per square inch.
.....	600	.0320	.0161	
.....	600	.0318	.0160	
326,550	2,100	.0715	.0230	
342,100	2,200	.0857	.0333	
.....	600	.0493	.0333	
.....	600	.0492	.0332	
367,000	2,360	.....	.....	Ultimate strength.

Opened longitudinal and oblique cracks in lower half of column. There was a gradual yielding of the column after reaching the ultimate strength. The loads sustained, then slowly dropped as the cracks developed. Test discontinued when the load had dropped to 310,000 pounds, at which time there were cracks 3 feet long, extending from the middle of the height of the column down to within one foot of the bottom.

No. 1712.

1 : 2 : 4 Mixture.

Reënforced with 4 Kahn bars, each ″.76×″.76 by 95″.95 long, with prongs bent toward center of column at an angle of 45° with axis; hooped with eleven hoops of $\frac{3}{8}$″ wire.



Composition, by volume: Alpha cement, 1; sand, 2; trap rock ($\frac{3}{4}$″), 4. Water, 85.1 per cent of cement, by weight.

Age, set in air, 5 months 11 days.

Weight of column, total, 1,310 pounds.

Weight of concrete, 1,206 pounds = 143.4 pounds per cubic foot.

Weight of Kahn bars and hoops, 104 pounds.

Height of column, 95.95 inches.

Sectional area of column, gross, 12″.45×12″.47 = 155.25 square inches.

Sectional area of vertical bars, ″.76×″.76 = □″.5776×4 = 2.31 square inches.

Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
15,525	100	0.	0.	Initial load. Loaded with 12,000 pounds before testing.
23,288	150	.0020	.0003	
31,050	200	.0041	.0010	
38,813	250	.0064	.0012	
46,575	300	.0085	.0014	
54,338	350	.0108	.0020	
62,100	400	.0128	.0022	
69,823	450	.0145	.0024	
77,625	500	.0165	.0027	
85,388	550	.0185	.0029	
93,150	600	.0205	.0033	E (100-600) = 1,453,000 pounds per square inch.
.....	600	.0208	.0035	
100,913	650	.0226	.0038	
108,675	700	.0246	.0040	
116,438	750	.0264	.0044	
124,200	800	.0285	.0046	
131,963	850	.0311	.0051	
139,725	900	.0331	.0055	
147,488	950	.0356	.0059	
155,250	1,000	.0373	.0063	E (600-1,000) = 1,449,000 pounds per square inch.
.....	600	.0276	.0063	
.....	600	.0274	.0063	

No. 1712—Continued.

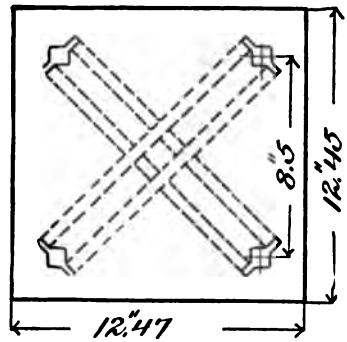
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
170,775	1,100	.0420	.0072	
186,300	1,200	.0470	.0084	
201,825	1,300	.0526	.0104	
217,350	1,400	.0588	.0131	
232,875	1,500	.0683	.0195	E (1,000–1,500)=1,404,000 pounds per square inch.
.....	600	.0440	.0196	
.....	600	.0440	.0196	
.....	200	.0257	.....	
.....	300	.0311	.....	
.....	400	.0361	.....	
.....	500	.0402	.....	
.....	600	.0439	.....	
.....	700	.0472	.....	
.....	800	.0504	.....	
.....	900	.0534	.....	
.....	1,000	.0561	.....	
.....	900	.0542	.....	
.....	800	.0519	.....	
.....	700	.0493	.....	
.....	600	.0464	.....	
.....	500	.0429	.....	
.....	400	.0387	.....	
.....	300	.0338	.....	
.....	200	.0273	.0202	
248,400	1,600	.0869	.0358	
263,925	1,700	.1100	.0556	Minute cracks visible.
279,450	1,800	.1570	.0800	Longitudinal and oblique cracks opened in lower 2 feet of length of column.
.....	600	.1019	.0800	
.....	600	.1015	.0800	
279,450	1,800	.....	.....	Ultimate strength.

Sustained 1,800 pounds per square inch on its second application for an interval of about two minutes, during which time the disintegration of the concrete went on. The principal disintegration occurred in a section 1 foot long, and at a distance of 1 foot from the lower end of the column. The deformation of the column was continued under reduced loads. The Kahn bars at the close of the test were found buckled outward, between two of the encircling $\frac{3}{8}$" steel hoops.

No. 1713.

1 : 2 : 4 Mixture.

Reënforced with 4 Kahn bars, each ″.76 × ″.76 by 95″.95 long, with prongs bent toward center of column at an angle of 90° to axis; hooped with eleven hoops of ⅜″ wire.



Composition, by volume: Alpha cement, 1; sand, 2; trap rock (¾″), 4. Water, 68 per cent of cement, by weight.

Age, set in air, 5 months 11 days.

Weight of column, total, 1,319 pounds.

Weight of concrete, 1,216 pounds = 144.6 pounds per cubic foot.

Weight of Kahn bars and hoops, 103 pounds.

Height of column, 95.95 inches.

Sectional area of column, gross, 12″.47 × 12″.45 = 155.25 square inches.

Sectional area of vertical bars, ″.76 × ″.76 = □″.5776 × 4 = 2.31 square inches.

Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
15,525	100	0.	0.	Initial load. Loaded with 12,000 pounds before testing.
23,288	150	.0015	.0002	
31,050	200	.0029	.0005	
38,813	250	.0042	.0008	
46,575	300	.0056	.0009	
54,338	350	.0071	.0010	
62,100	400	.0084	.0011	
69,823	450	.0098	.0012	
77,625	500	.0112	.0014	
85,388	550	.0127	.0016	
93,150	600	.0141	.0018	E (100–600) = 2,033,000 pounds per square inch.
.....	600	.0141	.0018	
100,913	650	.0154	.0020	
108,675	700	.0168	.0021	
116,438	750	.0182	.0023	
124,200	800	.0195	.0024	
131,963	850	.0211	.0026	
139,725	900	.0225	.0029	
147,488	950	.0239	.0030	
155,250	1,000	.0252	.0033	E (600–1,000) = 2,083,000 pounds per square inch.

No. 1713—Continued.

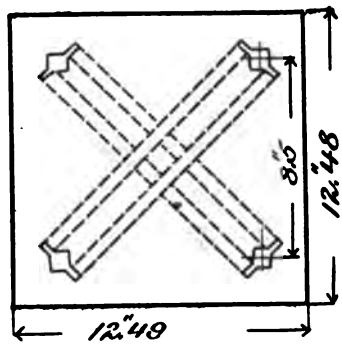
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
.....	600	.0174	.0032	
.....	600	.0175	.0032	
170,775	1,100	.0283	.0036	
186,300	1,200	.0314	.0039	
201,825	1,300	.0349	.0048	
217,350	1,400	.0390	.0059	
232,875	1,500	.0422	.0065	E (1,000-1,500) = 1,812,000 pounds per square inch.
.....	600	.0235	.0066	
.....	600	.0234	.0062	
248,400	1,600	.0469	.0080	
263,925	1,700	.0520	.0101	
279,450	1,800	.0570	.0129	
294,975	1,900	.0660	.0190	
310,500	2,000	.0740	.0248	E (1,500-2,000) = 1,852,000 pounds per square inch.
.....	600	.0425	.0249	
.....	600	.0424	.0246	
326,025	2,100	.0850	.0333	
341,550	2,200	.0984	.0434	
357,075	2,300	.1126	.0547	
372,600	2,400	.1330	.0720	
388,125	2,500	.1575	.0917	E (2,000-2,500) = 1,506,000 pounds per square inch.
394,000	2,538	.....	.....	Ultimate strength.

Opened longitudinal and oblique cracks in a section 2½ feet long, located about 2 feet from the upper end of the column. The principal crack took a zigzag, oblique course across the column 2 feet long.

No. 1716.

1:2:4 Mixture.

Reënforced with 4 Kahn bars, each ″.76 × ″.76 by 95″.95 long, with prongs bent toward center of column at an angle of 90° to axis.



Composition, by volume: Alpha cement, 1; sand, 2; trap rock (¾″), 4; water, 79.4 per cent of cement, by weight.

Age, set in air, 5 months 10 days.

Weight of column, total, 1,304 pounds.

Weight of concrete, 1,219 pounds = 143.8 pounds per cubic foot.

Weight of Kahn bars, 85 pounds.

Height of column, 95.95 inches.

Sectional area of column, gross, 12″.49 × 12″.48 = 155.88 square inches.

Sectional area of vertical bars, ″.76 × ″.76 = □″.5776 × 4 = 2.31 square inches.

Gauged length, 50″.

Applied loads.		In gauged length.		Remarks
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
15,588	100	0.	0.	Initial load. Loaded with 11,000 pounds before testing.
23,382	150	.0011	0.	
31,176	200	.0024	.0003	
38,970	250	.0039	.0005	
46,764	300	.0051	.0006	
54,558	350	.0063	.0007	
62,352	400	.0076	.0009	
70,146	450	.0090	.0011	
77,940	500	.0103	.0013	
85,734	550	.0116	.0016	
93,528	600	.0130	.0016	E (100-600) = 2,193,000 pounds per square inch.
.....	600	.0133	.0017	
101,322	650	.0144	.0018	
109,116	700	.0158	.0019	
116,910	750	.0172	.0021	
124,704	800	.0185	.0023	
132,498	850	.0203	.0027	
140,292	900	.0217	.0029	
148,086	950	.0232	.0031	
155,880	1,000	.0249	.0033	E (600-1,000) = 1,961,000 pounds per square inch.
.....	600	.0167	.0034	
.....	600	.0169	.0033	

No. 1716—Continued.

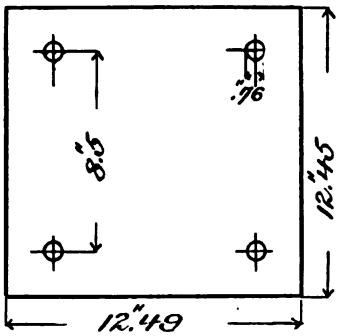
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
171,468	1,100	.0276	.0037	
187,056	1,200	.0314	.0044	
202,644	1,300	.0349	.0051	
218,232	1,400	.0391	.0061	
233,820	1,500	.0436	.0080	E (1,000-1,500)=1,786,000 pounds per square inch. Rested under initial load 16 hours.
.....	.....	.....	.0076	
233,820	1,500	.0483	.0103	
.....	600	.0277	.0102	
.....	600	.0275	.0102	
249,408	1,600	.0531	.0139	
264,996	1,700	.0623	.0198	
280,584	1,800	.0725	.0268	Minute cracks 2 feet from lower end.
296,172	1,900	.0915	.....	Ultimate strength.

Opened oblique and longitudinal cracks in a section 2 feet long, located 9″ from the lower end of the column.

No. 1715.

1:2:4 Mixture.

Reënforced with 4 Truscon bars, each ".76 diameter by 96".10 long, embraced by eleven hoops of ⅜" wire.



Composition, by volume: Alpha cement, 1; sand, 2; trap rock (¾"), 4. Water, 79.4 per cent of cement, by weight.

Age, set in air, 5 months 10 days.

Weight of column, total, 1,310 pounds.

Weight of concrete, 1,240.75 pounds = 145.8 pounds per cubic foot.

Weight of Truscon bars and hoops, 69¼ pounds.

Height of column, 96.10 inches.

Sectional area of column, gross, 12".45 × 12".49 = 155.50 square inches.

Sectional area of vertical bars, total, 1.81 square inches.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
15,550	100	0.	0.	Initial load. Loaded with 9,000 pounds before testing.
23,325	150	.0008	0.	
31,100	200	.0016	0.	
38,875	250	.0024	.0001	
46,650	300	.0035	.0003	
54,425	350	.0046	.0005	
62,200	400	.0056	.0005	
69,975	450	.0066	.0006	
77,750	500	.0079	.0010	
85,525	550	.0091	.0011	
93,300	600	.0102	.0012	E (100-600) = 2,778,000 pounds per square inch.
.....	600	.0103	.0013	
101,075	650	.0118	.0016	
108,850	700	.0129	.0017	
116,625	750	.0141	.0020	
124,400	800	.0155	.0022	
132,175	850	.0169	.0025	
139,950	900	.0184	.0028	
147,725	950	.0196	.0031	Rested under initial load 1 hour.
155,500	1,000	.0207	.0030	E (600-1,000) = 2,299,000 pounds per square inch.
.....	600	.0140	.0030	
.....	600	.0140	.0030	

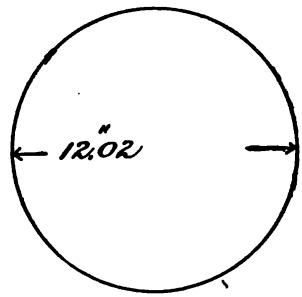
No. 1715—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
171,050	1,100	.0239	.0038	
186,600	1,200	.0267	.0043	
202,150	1,300	.0301	.0050	
217,700	1,400	.0338	.0060	
233,250	1,500	.0373	.0068	E (1,000-1,500)=1,953,000 pounds per square inch.
.....	600	.0202	.0068	
.....	600	.0201	.0067	
248,800	1,600	.0410	.0076	
264,350	1,700	.0458	.0087	
279,900	1,800	.0504	.0096	
295,450	1,900	.0565	.0116	
311,000	2,000	.0618	.0130	E (1,500-2,000)=1,366,000 pounds per square inch.
.....	600	.0313	.0129	
.....	600	.0310	.0126	
326,550	2,100	.0698	.0175	
342,100	2,200	.0815	.0245	
357,650	2,300	.0980	.0370	Cracks at corner, 26 inches from lower end of column.
367,500	2,363	.....	.....	Ultimate strength.

Opened oblique and longitudinal cracks in a section 2 feet long, located 18 inches from the lower end of the column.

No. 1705.

1:3:6 Mixture.
Plain column, without reënforcing bars.



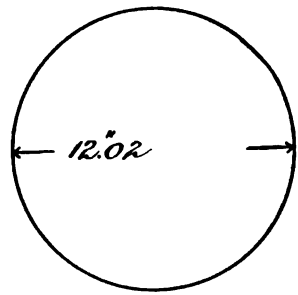
Composition, by volume: Alpha cement, 1; sand (10-mesh sieve), 3; trap rock ($\frac{1}{4}$" to $1\frac{1}{2}$"), 6.
Age, set in air, 5 months 5 days.
Weight of column, total, 922 pounds.
Weight of concrete, 922 pounds = 146.1 pounds per cubic foot.
Height of column, 96.12 inches.
Diameter of column, 12.02 inches.
Sectional area of column, 113.47 square inches.
Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
11,347	100	0.	0.	Initial load. Loaded with 9,060 pounds before testing.
17,021	150	.0006	0.	
22,694	200	.0014	.0002	
28,368	250	.0023	.0004	
34,041	300	.0032	.0006	
39,715	350	.0042	.0007	
45,388	400	.0054	.0010	
51,062	450	.0066	.0015	
56,735	500	.0079	.0019	
62,409	550	.0091	.0022	
68,082	600	.0107	.0028	E (100-600) = 3,165,000 pounds per square inch.
.....	600	.0109	.0030	
79,429	700	.0132	.0036	
90,776	800	.0162	.0047	
102,123	900	.0193	.0056	
113,470	1,000	.0228	.0070	E (600-1,000) = 2,532,000 pounds per square inch.
.....	600	.0159	.0070	
.....	600	.0160	.0070	
124,817	1,100	.0269	.0085	
136,164	1,200	.0320	.0107	
.....	600	.0206	.0106	
.....	600	.0205	.0106	
147,511	1,300	.0381	.0141	
.....	600	.0247	.0141	
.....	600	.0246	.0141	
158,858	1,400	.0480	.0200	
.....	600	.0314	.0197	
.....	600	.0311	.0197	
164,100	1,446	.....	.....	Ultimate strength.

Failed at a place 28 inches from upper end of column.

No. 1706.

1:3:6 Mixture.
Plain column, without reënforcing bars.



Composition, by volume: Alpha cement, 1; sand (10 mesh sieve), 3; pebbles, ($\frac{1}{4}$" to 1$\frac{1}{2}$"), 6. Water, 78.8 per cent of cement, by weight.
Age, set in air, 5 months 3 days.
Weight of column, total, 808 pounds.
Weight of concrete, 808 pounds = 128 pounds per cubic foot.
Height of column, 96.06 inches.
Diameter of column, 12.02 inches.
Sectional area of column, 113.47 square inches.
Gauged length, 50".

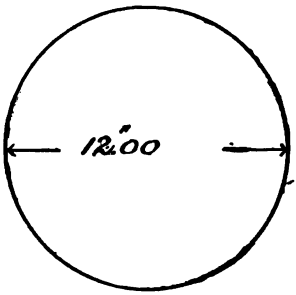
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
11,347	100	0.	0.	Initial load. Loaded with 6,000 pounds before testing.
17,021	150	.0008	0.	
22,694	200	.0016	.0001	
28,368	250	.0025	.0003	
34,041	300	.0035	.0005	
39,715	350	.0046	.0007	
45,388	400	.0058	.0009	
51,062	450	.0071	.0012	
56,735	500	.0084	.0015	
62,409	550	.0098	.0019	
68,082	600	.0113	.0024	E (100-600) = 2,809,000 pounds per square inch.
.....	600	.0116	.0026	
79,429	700	.0140	.0033	
90,776	800	.0175	.0043	
102,123	900	.0205	.0052	
113,470	1,000	.0242	.0067	E (600-1,000) = 2,326,000 pounds per square inch.
.....	600	.0168	.0067	
.....	600	.0167	.0067	
124,817	1,100	.0288	.0085	
136,164	1,200	.0341	.0113	
.....	600	.0224	.0111	
.....	600	.0223	.0111	
143,000	1,260	.....	.....	Ultimate strength.

Failed at a place 18 inches from lower end of column.

No. 1707.

1:3:6 Mixture.

Plain column, without reënforcing bars.



Composition, by volume: Alpha cement, 1; sand (10 mesh sieve), 3; cinders, 6.

Age, set in air, 5 months.

Weight of column, total, 638 pounds.

Weight of concrete, 638 pounds = 101.4 pounds per cubic foot.

Height of column, 96.12 inches.

Diameter of column, 12 inches.

Sectional area of column, 113.10 square inches.

Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
11,310	100	0.	0.	Initial load. Loaded with 7,000 pounds before testing.
16,965	150	.0022	.0002	
22,620	200	.0045	.0007	
28,275	250	.0073	.0011	
33,930	300	.0103	.0017	
39,585	350	.0133	.0023	
45,240	400	.0168	.0032	
50,895	450	.0200	.0038	
56,550	500	.0237	.0048	
62,205	550	.0272	.0055	
67,860	600	.0316	.0067	E (100–600) = 1,004,000 pounds per square inch.
.....	600	.0322	.0075	
78,900	698	.....	.....	Ultimate strength.

Failed at upper end of column. The concrete in this vicinity had been patched with cement mortar to fill some voids.

TABULATION OF COMPRESSIVE STRENGTH OF CONCRETE AND MORTAR COLUMNS, PLAIN AND REËNFORCED.

Height of columns, 8 feet.
Alpha Portland cement used.

Number of test.	Diameter of column.	Composition.				Age.		Reënforcing metal.		Sectional areas.			Weight of concrete or mortar per cubic foot.	Compressive strength.	
		Cement.	Sand.	Stone or cinder.	Kind of stone or cinder.	Mos.	Days	Description.	Metal in longitudinal bars.	Gross.	Concrete or mortar.	Bars.		Total.	Per square inch on gross area.
	Inches.								*Per ct.*	*Sq. in.*	*Sq. in.*	*Sq. in.*	*Pounds.*	*Pounds.*	*Pounds.*
1718	12.35	1	2	4	¾" to 1½" trap rock.	5	8	2" mesh steel wire cage; 49 circular wires ".104 diameter each.	None.	119.79	119.79	0.	149.8	263,538	2,200
1722	12.25	1	2	4	.....do.....	5	13	3" mesh steel wire cage; 33 circular wires ".104 diameter each.	None.	117.86	117.86	0.	151.3	242,000	2,053
1724	12.45	1	2	4	.....do.....	5	13	3" mesh steel wire cage; 33 circular wires ".145 diameter each.	None.	121.74	121.74	0.	149.4	318,000	2,610
1720	12.25	1	3	6	.....do.....	5	8	2" mesh steel wire cage; 49 circular wires ".104 diameter each.	None.	117.86	117.86	0.	150.1	159,111	1,350
1719	12.45	1	3	6	.....do.....	5	8	2" mesh steel wire cage; 49 circular wires ".144 diameter each.	None.	121.74	121.74	0.	145.7	168,000	1,380
1721	12.40	1	3	6	.....do.....	5	8	.....do.....	None.	120.76	120.76	0.	143.1	183,500	1,520
1723	12.34	1	3	6	.....do.....	5	12	3" mesh steel wire cage; 33 circular wires ".104 diameter each.	None.	119.60	119.60	0.	147.6	197,340	1,650
1725	12.35	1	3	6	.....do.....	5	11	3" mesh steel wire cage; 33 circular wires ".145 diameter each.	None.	119.79	119.79	0.	149.6	206,000	1,720
1734	10.40	1	1	0	None.....	6	11	None.....	None.	84.95	84.95	0.	132.6	367,000	4,320
1735	10.40	1	1	0	.....do.....	6	12	25 hoops 1".5 wide by ".12 thick and 4 angles.	1.07	84.95	84.04	0.91	132.6	508,000	5,980
1730	10.45	1	1	2	¾" to 1½" trap rock.	5	0	.....do.....	1.06	85.77	84.86	0.91	149.1	466,000	5,433
1736	10.38	1	4	0	None.....	6	8	None.....	None.	84.62	84.62	0.	118.7	88,851	1,050
1737	10.40	1	4	0	.....do.....	6	8	25 hoops 1".5 wide by ".12 thick, and 4 angles.	1.07	84.95	84.04	0.91	119.9	235,000	2,766
1733	10.40	1	4	8	¾" to 1½" trap rock.	6	11	.....do.....	1.07	84.95	84.04	0.91	146.6	255,000	3,002
1731	10.40	1	2	4	.....do.....	5	16	None.....	None.	84.95	84.95	0.	150.0	120,000	1,413
1740	10.38	1	2	4	.....do.....	6	6	13 hoops 1".5 wide by ".12 thick.....	None.	84.62	84.62	0.	149.2	188,900	2,232
1741	10.38	1	2	4	.....do.....	6	5	25 hoops 1".5 wide by ".12 thick.....	None.	84.62	84.62	0.	148.6	290,100	3,428
1739	10.35	1	2	4	.....do.....	6	6	47 hoops 1".5 wide by ".12 thick.....	None.	84.13	84.13	0.	149.4	445,000	5,289

1738	10.38	1	2	4	.....do.....	6	7	13 hoops 1".5 wide by ".12 thick, and 4 angles.	1.08	84.62	83.71	0.91	150.7	256,300	3,029
1692	10.40	1	2	4	.....do.....	0	15	25 hoops 1".5 wide by ".12 thick, and 4 angles.	1.07	84.95	84.04	0.91	144.2	260,400	3,065
1726	10.30	1	2	4	.....do.....	5	12	.....do.....	1.09	83.32	82.41	0.91	150.7	349,000	4,189
1728	12.00	1	2	4	.....do.....	5	12	.....do.....	0.80	113.10	112.19	0.91	149.4	370,000	3,271
1746	10.36	1	2	4	¼" to ¾" trap rock..	5	12	48 hoops 1".04 wide by ".06 thick, and 4 angles.	1.08	84.30	83.39	0.91	147.2	324,000	3,843
1744	11.95	1	2	4	.....do.....	6	0	.....do.....	0.81	112.16	111.25	0.91	148.2	335,200	2,989
1732	10.38	1	3	6	¾" to 1½" trap rock.	5	11	None.....	None.	84.62	84.62	0.	148.2	63,465	750
1742	10.38	1	3	6	.....do.....	6	4	25 hoops 1".5 wide by ".12 thick.....	None.	84.62	84.62	0.	145.9	162,300	1,918
1743	10.38	1	3	6	Cinders.....	6	4	.....do.....	None.	84.62	84.62	0.	101.3	96,000	1,134
1727	10.35	1	3	6	¾" to 1½" trap rock.	5	11	25 hoops 1".5 wide by ".12 thick, and 4 angles.	1.08	84.13	83.22	0.91	148.3	325,000	3,863
1729	12.02	1	3	6	.....do.....	5	3	.....do.....	0.80	113.47	112.56	0.91	144.6	299,000	2,634
1747	10.36	1	3	6	¼" to ¾" trap rock..	5	11	48 hoops 1".06 wide by ".06 thick, and 4 angles.	1.08	84.30	83.39	0.91	138.9	212,000	2,515
1745	11.95	1	3	6	.....do.....	5	13	48 hoops 1".04 wide by ".06 thick, and 4 angles.	0.81	112.16	111.25	0.91	142.2	259,000	2,309
1714	12.00	1	2	4	¾" trap rock.....	5	11	3 Kahn bars and 11 hoops.....	1.53	113.10	111.37	1.73	145.4	265,500	2,350
1717	12.00	1	2	4	.....do.....	5	8	3 Kahn bars and 1 hoop.....	1.53	113.10	111.37	1.73	145.6	237,510	2,100
1711	12.48×12.46	1	2	4	.....do.....	5	15	4 Kahn bars.....	1.41	155.50	153.31	2.19	136.3	367,000	2,360
1712	12.45×12.47	1	2	4	.....do.....	5	11	4 Kahn bars and 11 hoops	1.49	155.25	152.94	2.31	143.4	279,450	1,800
1713	12.45×12.47	1	2	4	.....do.....	5	11	.....do.....	1.49	155.25	152.94	2.31	144.6	394,000	2,538
1716	12.48×12.49	1	2	4	.....do.....	5	10	4 Kahn bars.....	1.48	155.88	153.57	2.31	143.8	296,172	1,900
1715	12.45×12.49	1	2	4	.....do.....	5	10	4 Truscon bars and 11 hoops.....	1.16	155.50	153.69	1.81	145.8	367,500	2,363
1705	12.02	1	3	6	¾" to 1½" trap rock.	5	5	None.....	None.	113.47	113.47	0.	146.1	'64,100	1,446
1706	12.02	1	3	6	¼" to 1½" pebbles...	5	3	.....do.....	None.	113.47	113.47	0.	128.0	43,000	1,260
1707	12.00	1	3	6	Cinders.....	5	0	.....do.....	None.	113.10	113.10	0.	101.4	78,900	698

DIAGRAMS ILLUSTRATING FEATURES OF THE TESTS OF CONCRETE AND MORTAR COLUMNS.

PREPARED FROM RESULTS IN THE PRESENT VOLUME, AND FROM TESTS OF METALS, 1904 AND 1905.

COLUMNS 8 FEET HIGH.

Diagram No. 1.

COMPRESSIVE STRENGTH OF PLAIN AND REËNFORCED MORTAR COLUMNS.

The reënforcement consisted of twisted steel bars, the percentage of metal being from 2.85 to 4.63 per cent, the darker shaded portions of the diagram indicating the relative amounts.

The test numbers and locations of detailed results are as follows:

Composition.	Number of test.	Date of report.	Page.
1 : 1 plain	1618	1904	348
1 : 2 plain	1682	1905	298
1 : 3 plain	1681	1905	305
1 : 4 plain	1679	1905	308
1 : 5 plain	1687	1905	314
1 : 2 reënforced	1673	1905	316
1 : 3 reënforced	1690	1905	318
1 : 4 reënforced	1691	1905	322
1 : 5 reënforced	1688	1905	326
1 : 5 reënforced	1689	1905	329

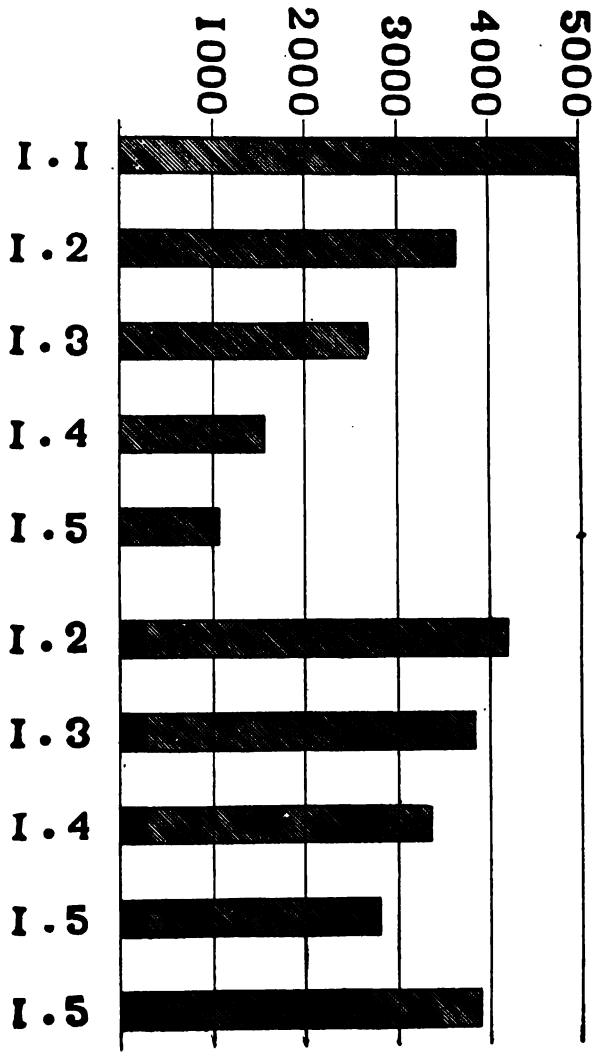


DIAGRAM No. 1.—Compressive strength of plain and reinforced mortar columns.

Diagram No. 2.

COMPRESSIVE STRENGTH OF PLAIN AND REËNFORCED MORTAR COLUMNS AND CORRESPONDING CONCRETES.

The reënforcement consisted of hoops and angle bars, the latter extending longitudinally from end to end of column.

The test numbers and locations of the detailed results are as follows:

Composition.	Number of test.	Date of report.	Page.
1 : 1 plain	1734	1906	473
1 : 1 reënforced	1735	1906	476
1 : 1 : 2 reënforced	1730	1906	479
1 : 4 plain	1736	1906	483
1 : 4 reënforced	1737	1906	484
1 : 4 : 8 reënforced	1733	1906	486

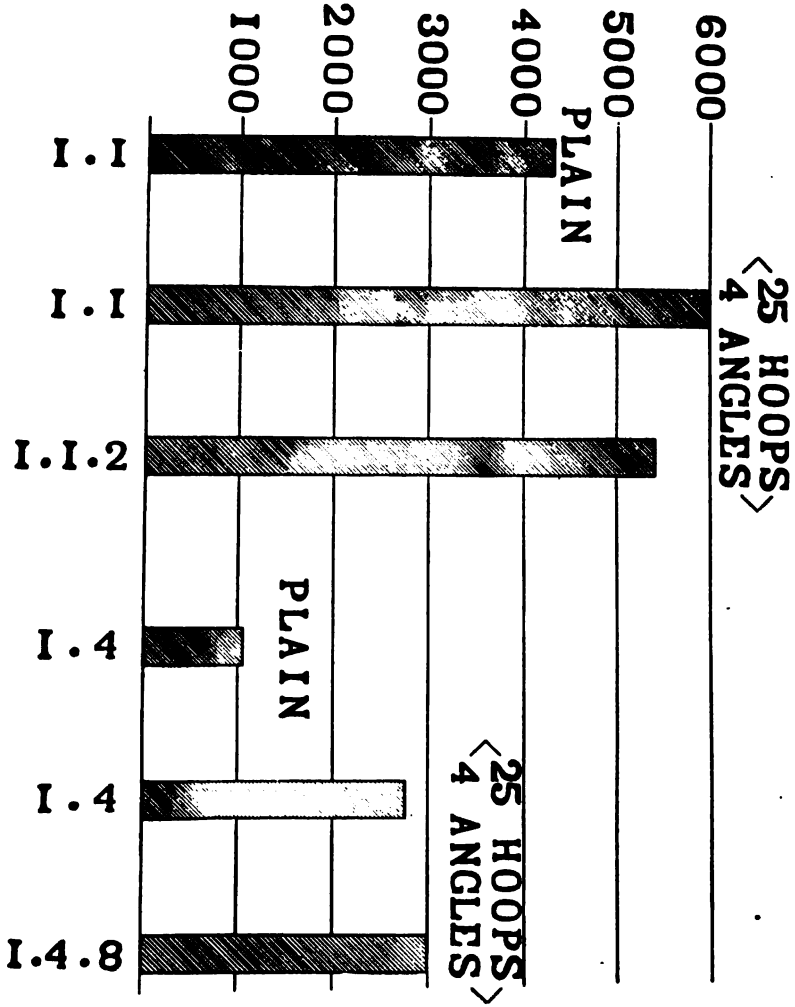


DIAGRAM No. 2.—Compressive strength of plain and reinforced mortar and concrete columns.

Diagram No. 3.

COMPRESSIVE STRENGTH OF CONCRETE COLUMNS, PLAIN AND REËNFORCED WITH HOOPS, AND WITH HOOPS AND ANGLE BARS.

The progressive gain in ultimate strength by increasing the number of hoops and by the addition of the longitudinal angle bars to a given number of hoops is shown.

The test numbers and locations of the detailed results are as follows:

Composition.	Number of test.	Date of report.	Page.
1 : 2 : 4 plain	1731	1906	489
1 : 2 : 4 reënforced with 13 hoops	1740	1906	490
1 : 2 : 4 reënforced with 13 hoops and 4 angles	1738	1906	497
1 : 2 : 4 reënforced with 25 hoops	1741	1906	492
1 : 2 : 4 reënforced with 25 hoops and 4 angles	1726	1906	501
1 : 2 : 4 reënforced with 47 hoops	1739	1906	494

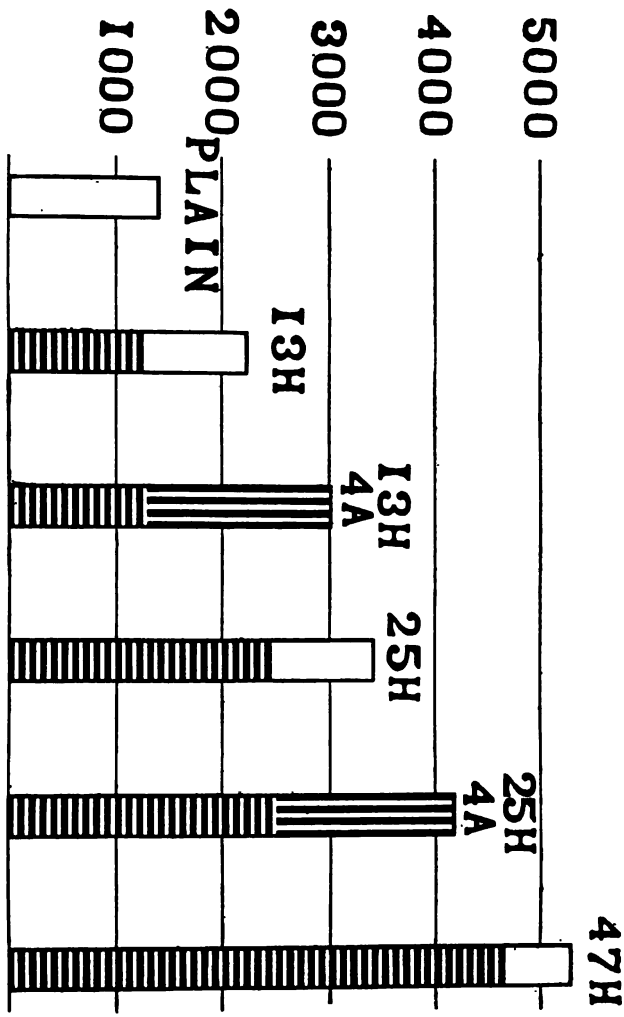


DIAGRAM No. 3.—Compressive strength of concrete columns, plain and reënforced with hoops, and with hoops and angle bars.

DIAGRAM NO. 4.

COMPRESSIVE STRENGTH OF MORTAR AND CONCRETE COLUMNS, PLAIN AND REËNFORCED WITH LONGITUDINAL BARS OF TWISTED STEEL, AND WITH HOOPS AND ANGLE BARS.

The test numbers and locations of the detailed results are as follows:

Composition.	Number of test.	Date of report.	Page.
1 : 1 plain	1618	1904	348
1 : 1 : 2 plain	1656	1905	331
1 : 2 reënforced with 8 ¾″ bars	1673	1905	316
1 : 5 reënforced with 13 ¾″ bars	1689	1905	329
1 : 2 : 4 reënforced with 25 hoops and 4 angles	1726	1906	501
1 : 3 : 6 reënforced with 25 hoops and 4 angles	1727	1906	513
1 : 4 : 8 reënforced with 25 hoops and 4 angles	1733	1906	486

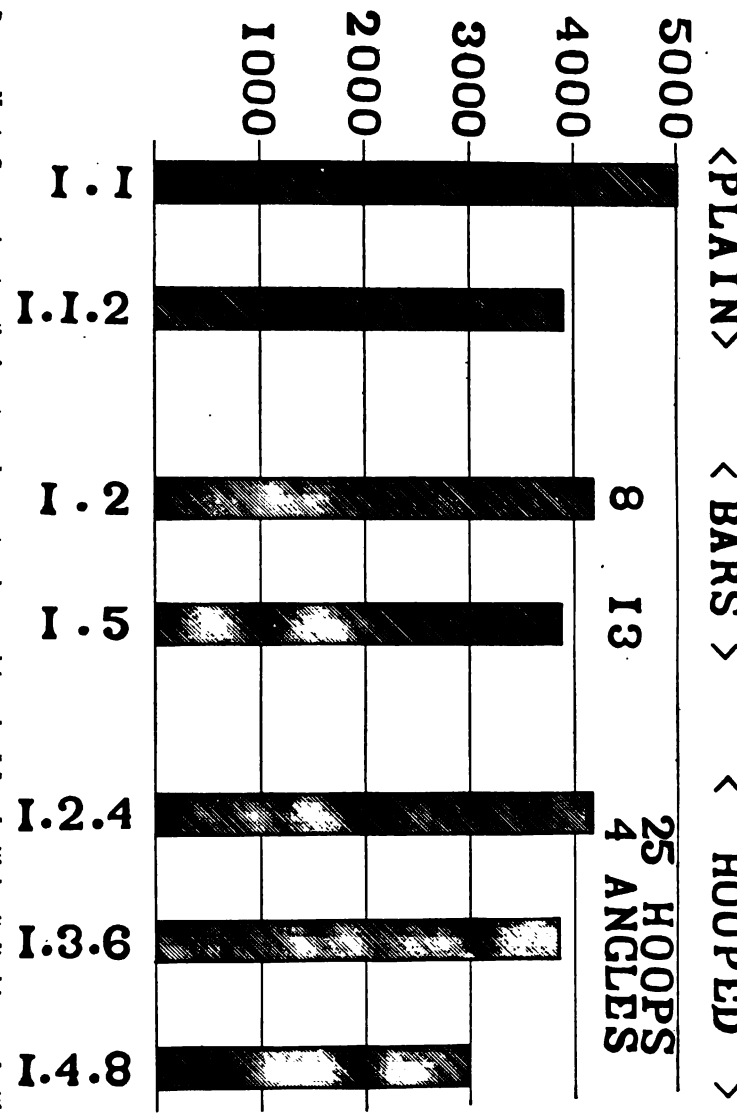


DIAGRAM No. 4.—Compressive strength of mortar and concrete columns, plain and reinforced with longitudinal bars, and with hoops and angle bars.

Diagram No. 5.

The stress-strain curves of this diagram pertain to the columns which are represented on diagram No. 4. The order in which these curves appear is the same as the figures on diagram No. 4, excepting the 1:1 mortar and the 1:1:2 concrete have changed places, the latter appearing first on the left of this group.

The order of the curves is as follows:

1 : 1 : 2 concrete, plain.
1 : 1 mortar, plain.
1 : 2 mortar, reënforced.
1 : 5 mortar, reënforced.
1 : 2 : 4 concrete, reënforced.
1 : 3 : 6 concrete, reënforced.
1 : 4 : 8 concrete, reënforced.

The ordinates of the diagram represent compressive stresses, in pounds per square inch, and the abscissas the compressive strains of the columns, observed on a gauged length of 50″.

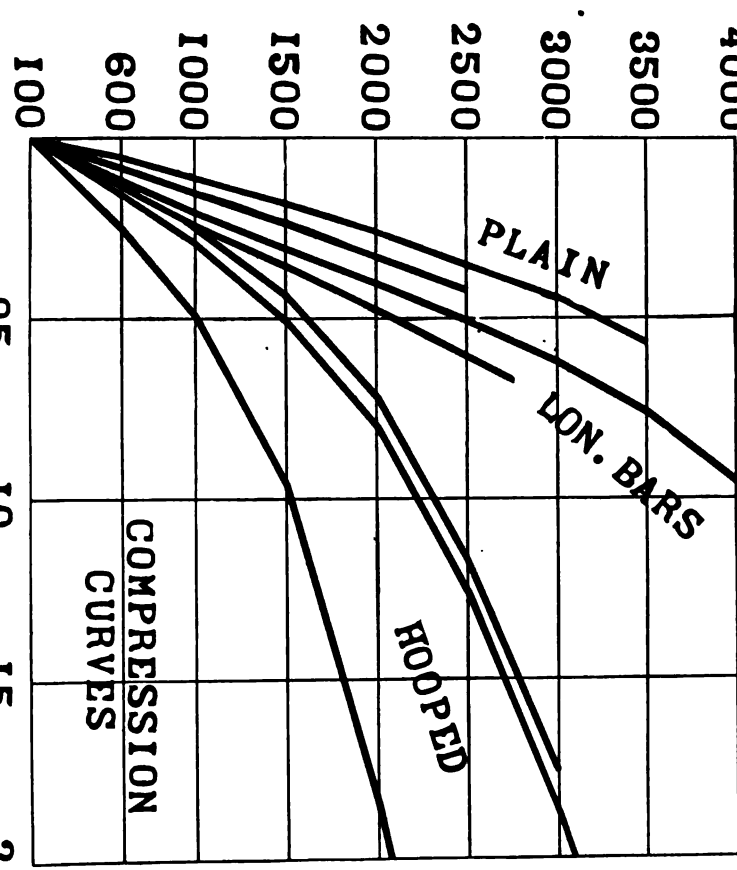


DIAGRAM No. 5.—Stress-strain curves of mortar and concrete columns, the compressive strengths of which are represented on diagram No. 4.

DIAGRAM NO. 6.

This diagram illustrates the range of compressibility and sets which are developed in a number of mixtures. The several curves refer to columns reënforced by hooping, excepting the 1 : 1 mortar. No curve of sets appears for the column of 1 : 3 : 6 mixture, in which trap rock formed the aggregate. The coordinates refer to stresses and strains, described in the same manner as those of diagram No. 5.

The test numbers and location of the detailed results of the columns represented are as follows:

Composition.	Number of test.	Date of report.	Page.
1 : 1 mortar, plain	1734	1906	473
1 : 2 : 4 concrete	1741	1906	492
1 : 3 : 6 concrete	1747	1906	517
1 : 3 : 6 concrete (cinder)	1743	1906	512

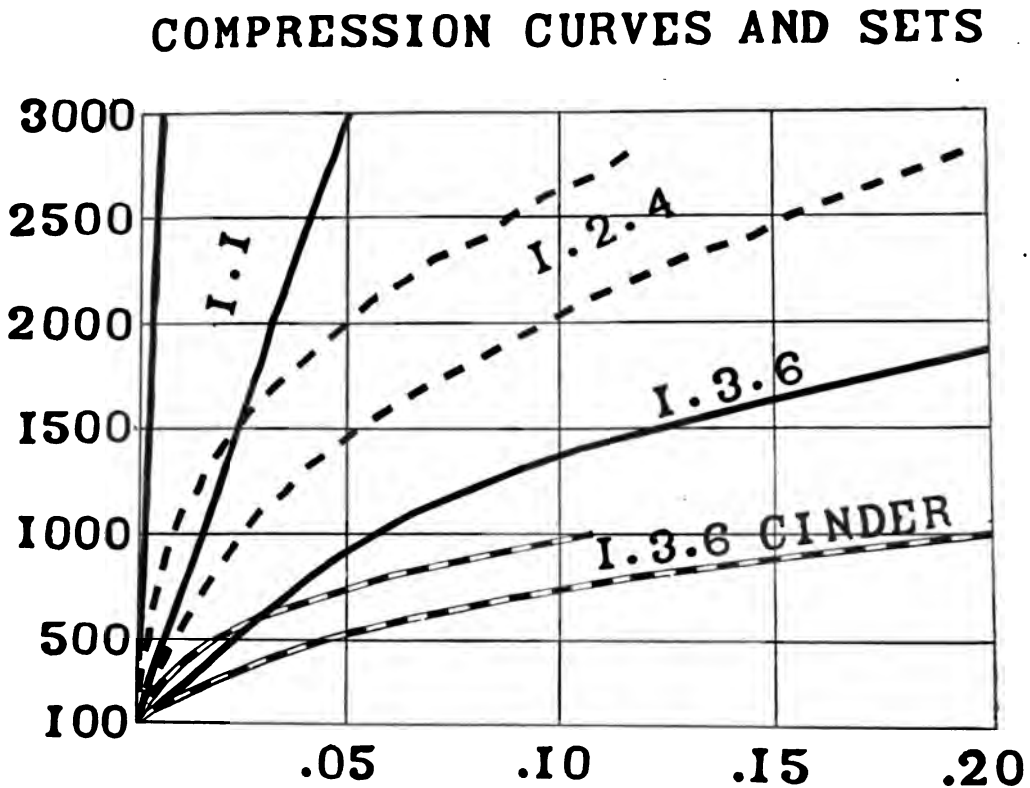


DIAGRAM No. 6.—Stress-strain curves, compressions and sets, of mortar and concrete columns of different compositions.

DIAGRAM No. 7.

The moduli of elasticity, at different stages of the tests, of four mortar and concrete columns are here indicated. These values, representing compressive strains developed in passing from the initial load of 100 pounds to 600 pounds per square inch, were obtained from observations made when the columns were first loaded and at times thereafter following the application of successively higher stresses, returning in each case to the range of 500 pounds per square inch.

Neat cement and rich mortars do not show any considerable loss in the value of the modulus of elasticity when examined over an early range of loads succeeding the application of higher stresses. Other mixtures are subject to decided changes, the rate of compressibility under lower stresses being increased as the result of successively higher stresses having been applied to the concrete or mortar.

The test numbers and locations of the detailed results of the columns here represented are as follows:

Composition.	Number of test.	Date of report.	Page.
1:1 mortar, plain	1734	1906	473
1:2:4 concrete, reënforced with 25 hoops	1741	1906	492
1:3:6 concrete, reënforced with 48 hoops and 4 angles	1745	1906	519
1:3:6 cinder concrete, reënforced with 25 hoops	1743	1906	512

The original and successive numerical values of the moduli of elasticity after the application of different loads are as follows:

NO. 1734, 1:1 MORTAR, PLAIN

	Pounds per square inch.
Original value of E	3,378,000
After a load of 1,000 pounds	3,247,000
After a load of 1,500 pounds	3,247,000
After a load of 2,000 pounds	3,205,000
After a load of 2,500 pounds	3,165,000
After a load of 3,000 pounds	3,086,000
After a load of 3,500 pounds	3,086,000

NO. 1741, 1:2:4 CONCRETE, 25 HOOPS.

	Pounds per square inch.
Original value of E	2,874,000
After a load of 1,000 pounds	2,551,000
After a load of 1,500 pounds	2,016,000
After a load of 2,000 pounds	1,582,000
After a load of 2,500 pounds	1,337,000
After a load of 2,800 pounds	1,244,000

NO. 1745, 1:3: 6 CONCRETE, 48 LIGHT HOOPS, 4 ANGLE BARS.

	Pounds per square inch.
Original value of E	1,220,000
After a load of 1,000 pounds	899,000
After a load of 1,500 pounds	801,000
After a load of 2,000 pounds	912,000

NO. 1743, 1:3: 6 CONCRETE, CINDER, 25 HOOPS.

	Pounds per square inch.
Original value of E	702,000
After a load of 850 pounds	538,000
After a load of 1,000 pounds	426,000

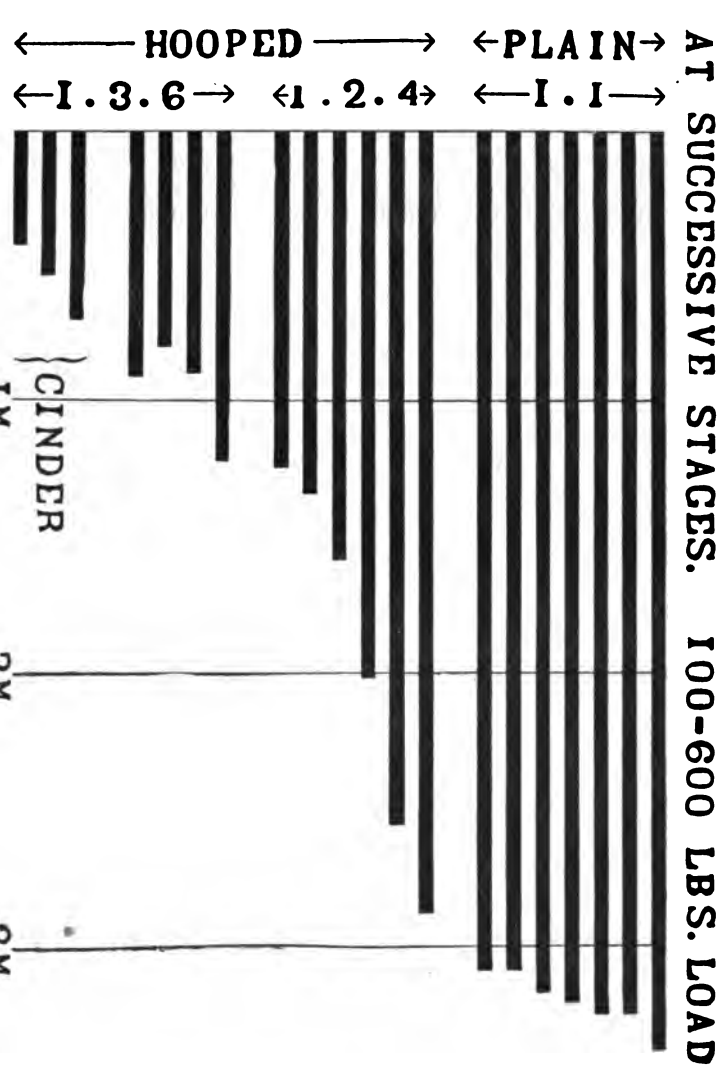


DIAGRAM No. 7.—Moduli of elasticity, range of stress from 100 to 600 pounds per square inch, of mortar and concrete columns. Original values and after successively higher loads had been applied and released.

Diagram No. 8.

The stress-strain curves for ascending and descending loads follow different paths, as indicated on this diagram. The departure has been observed to increase after the application of successively higher loads, and also to be greater for lean mixtures than for rich ones.

The curves here shown were obtained after the several columns described below had been loaded as follows:

Composition.	Number of test.	Date of report.	Page.	Previous load per square inch.
				Pounds.
1 : 1 mortar, plain	1734	1906	473	3,500
1 : 1 mortar, reënforced with 25 hoops and 4 angle bars	1735	1906	476	5,700
1 : 4 : 8 concrete, reënforced with 25 hoops and 4 angles	1733	1906	486	2,500
1 : 2 : 4 concrete, reënforced with 47 hoops	1739	1906	494	3,200

The coordinates refer to stresses and strains described in the same manner as those of diagram No. 5, the origins of the several curves being located at different places on the diagram.

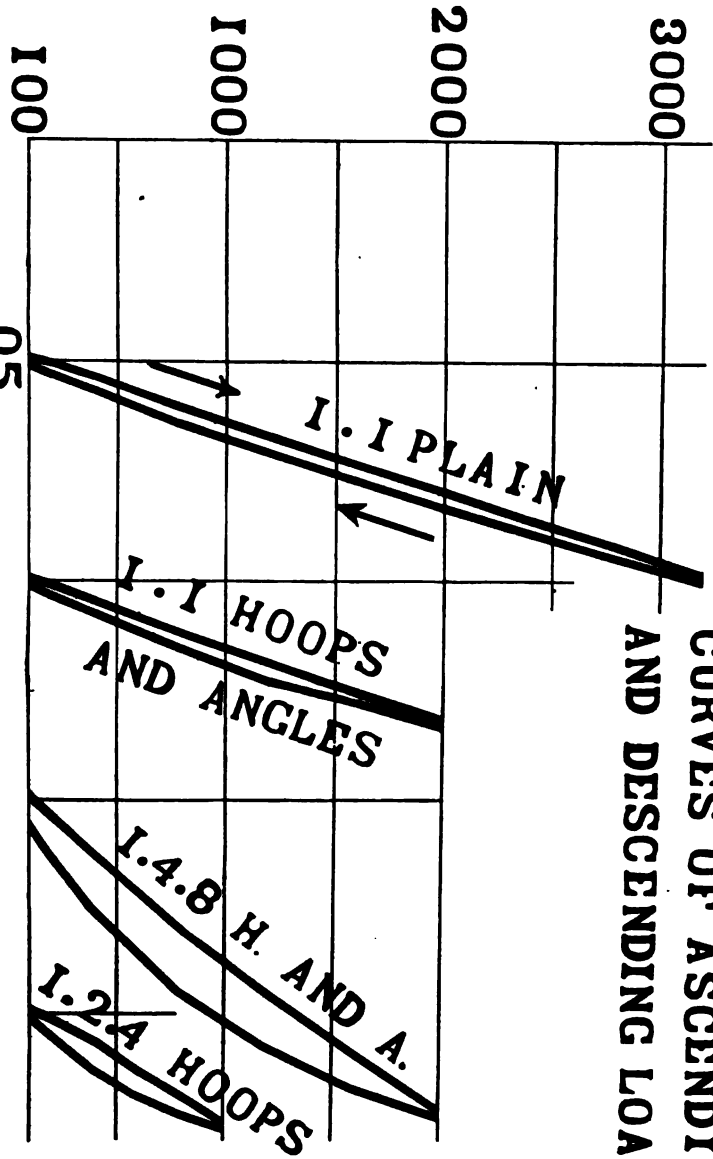
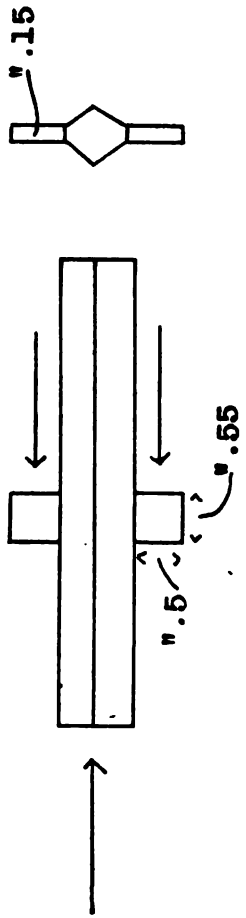


DIAGRAM No. 8.—Stress-strain curves of mortar and concrete columns, plain and reinforced, for ascending and descending stresses.

STEEL BARS USED IN CONCRETE CONSTRUCTION.

Tests of Metal in Kahn Bars.

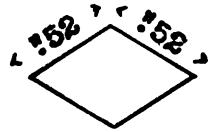
Shearing Tests, Bar No. 8.



Projecting wings sheared off; two samples used.

No. of sample.	Shearing planes.	Shearing area.	Shearing strength.	
			Total.	Per square inch.
		Sq. inch.	*Pounds.*	*Pounds.*
1	".55 by ".15 by 2	.165	7,420	44,970
2	".55 by ".15 by 2	.165	7,340	44,480

TENSILE TEST, BAR NO. 7.



Wings removed and body of bar tested.
Dimensions, ″.52 by ″.52.
Sectional area, .27 square inch.
Gauged length, 10″.

Applied loads.		Elongation.	Set.	Remarks.
Total.	Per square inch.			
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
9,400	34,820	.....	.....	Elastic limit.
10,260	38,000	.03	.....	
10,800	40,000	.03+	.....	
12,150	45,000	.09	.....	
13,500	50,000	.19	.....	
14,850	55,000	.26	.....	
16,200	60,000	.37	.....	
17,550	65,000	.51	.....	
18,900	70,000	.77	.....	
19,400	71,850	.....	.....	Tensile strength.
0	0	.88	.....	=8.8 per cent elongation.

Elongation of inch sections: ″.07, ″.07, ″.07, ″.09, ″.09, ″.10, ″.09, ″.09, ″.09, ″.12.

Area at fracture, ″.47 by ″.48=.23 square inch.

Contraction of area, 14.8 per cent.

Appearance of fracture, silky, oblique. Fractured outside the gauged length.

JOINTS IN STEEL BARS FOR CONCRETE CONSTRUCTION.

STEEL BARS, OVERLAPPED, IMBEDDED IN PRISMS OF CONCRETE, AND CLAMPED TOGETHER WITH WIRE ROPE CLIPS; ALSO BARS, NOT IMBEDDED, CLAMPED TOGETHER.

Material furnished by the Aberthaw Construction Company.

Resistance of Overlapping Steel Rods Imbedded in Concrete Prisms, Clamped Together with Wire Rope Clips, and Rods Without Clips.

There were helical wrappings of $\frac{3}{16}$" twisted square steel wire or No. 10 round wire, which surrounded the overlapping ends of some of the imbedded rods.

No. of specimen.	Size of rods.	Kind of rods.	Clips.	Lap of rods.	Interior wrapping of—	Dimensions of concrete.		Free length of rods between concrete and machine heads.	Rapid yielding.	Ultimate strength.	Remarks.
						Length.	Cross section.				
				"		"	" " "	" " "	*Pounds.*	*Pounds.*	
1	1½" square	Twisted	Two 1½" Crosby	18	⅜" twisted	24	9.92 by 10.04	29+32=61	17,000	28,800	
1 w	do	do	do	18	No. 10 wire	24	9.99 by 10.04	30+31=61	14,300	29,600	
2	do	do	do	50	⅜" twisted	56.10	9.83 by 10.00	28+50=78	39,000	83,000	
2 w	do	do	do	50	No. 10 wire	56.15	9.95 by 9.95	28+29=57	41,000	87,000	
3	1½" diameter	Round	Two 1½" Crosby	18	⅜" twisted	24	10.00 by 10.06	29+29=58	23,000	42,000	
3 w	do	do	do	18	No. 10 wire	24	9.92 by 10.00	28+29=57	20,000	35,800	
4	do	do	do	50	⅜" twisted	56.25	10.02 by 10.07	25+26=51	23,000	46,000	
4 w	do	do	do	50	No. 10 wire	56	10.15 by 10.20	26+26=52	25,000	46,000	
5	1" square	Twisted	do	18	⅜" twisted	24	8.01 by 8.07	30+30=60	15,000	29,400	
5 w	do	do	do	18	No. 10 wire	24	8.02 by 7.88	30+30=60	17,000	47,500	One 1¼" and one 1½" clip.
6	do	do	do	40	⅜" twisted	46	8.12 by 8.15	29+29=58	38,000	63,000	
6 w	do	do	do	40	No. 10 wire	46	8.10 by 8.19	28+28=56	39,000	66,500	
7	1" diameter	Round	Two 1" Crosby	18	⅜" twisted	24	7.93 by 8.08	30+28=58	18,000	31,200	
7 w	do	do	do	18	No. 10 wire	24	7.90 by 8.12	29+29=58	20,000	28,400	
8 w	do	do	do	40	⅜" twisted	46	8.00 by 8.10	29+28=57	19,000	27,000	
8	do	do	do	40	No. 10 wire	46	7.96 by 8.02	28+29=57	17,000	30,500	
9	1½" square	Twisted	None	18	".135 diameter wire.	24	9.83 by 10.16	30+30=60	13,200	28,700	
10	do	do	do	50	No. 10 wire	56.30	9.83 by 10.10	27+28=55	58,800	87,000	
11	1½" diameter	Round	do	18	do	24	9.96 by 10.18	30+30=60	25,000	35,800	
12	do	do	do	50	do	56.25	10.18 by 10.18	38+26=64	46,000	51,800	Scale started off one bar at 50,000 pounds tension.
13	1" square	Twisted	do	18	do	24	7.83 by 8.16	30+28=58	27,600	38,200	
14	do	do	do	40	do	46	8.22 by 8.10	30+28=58	53,000	59,000	
15	1" diameter	Round	do	18	do	24	7.98 by 8.28	29+31=60	21,000	21,000	
16	do	do	do	40	do	46.25	8.16 by 8.16	33+26=59	30,000	35,800	

RESISTANCE OF OVERLAPPING STEEL RODS IMBEDDED IN CONCRETE PRISMS, CLAMPED TOGETHER WITH WIRE ROPE CLIPS, AND RODS WITHOUT CLIPS—Continued.

No. of specimen.	Size of rods.	Kind of rods.	Clips.	Lap of rods.	Interior wrapping of—	Dimensions of concrete.		Free length of rods between concrete and machine heads.	Rapid yielding.	Ultimate strength.	Remarks.
						Length.	Cross section.				
						"	" "	" " "	*Pounds.*	*Pounds.*	
17	1¼" square	Twisted	Two 1¼" Crosby	18	None	24	9.82 by 10.10	30+30=60	37,000	38,100	
18	1¼" diameter	Round	Two 1¼" Crosby	18	do	24	9.83 by 10.25	29+30=59	31,000	35,000	
19	1" square	Twisted	do	18	do	24	10.00 by 9.96	30+29=59	31,000	31,000	Cement rotated ¼ turn.
20	1" diameter	Round	Two Crosby	18	do	25	9.97 by 10.25	29+29=58	25,000	35,000	
21	1½" round	Plain	None	30	No. 10 wire	36.15	11.80 by 12.05	25+23=48	30,000	40,200	
22	do	do	do	60	do	66.15	11.83 by 12.10	42+42=84	29,000	35,800	
23	do	do	Two 1½" Crosby	30	do	36.3	11.85 by 12.10	23+24=47	36,000	87,200	
24	do	do	do	30	None	Naked bars		26+36=62	10,000	72,000	
25	do	do	do	30	do	do		27+26=53	12,000	[a] 22,000	
26	do	do	Eight 1½" Crosby	36	do	do		30+36=66	57,000	106,400	
27	1½" round	do	Two 1½" Crosby	15	do	do		Ends not upset.	[b] 16,900	26,600	New clips used.
28	do	do	Three 1½" Crosby	15	do	do		do	24,400	44,300	Do.

[a] Test discontinued.

[b] First slip.

DETAILS OF TESTS.

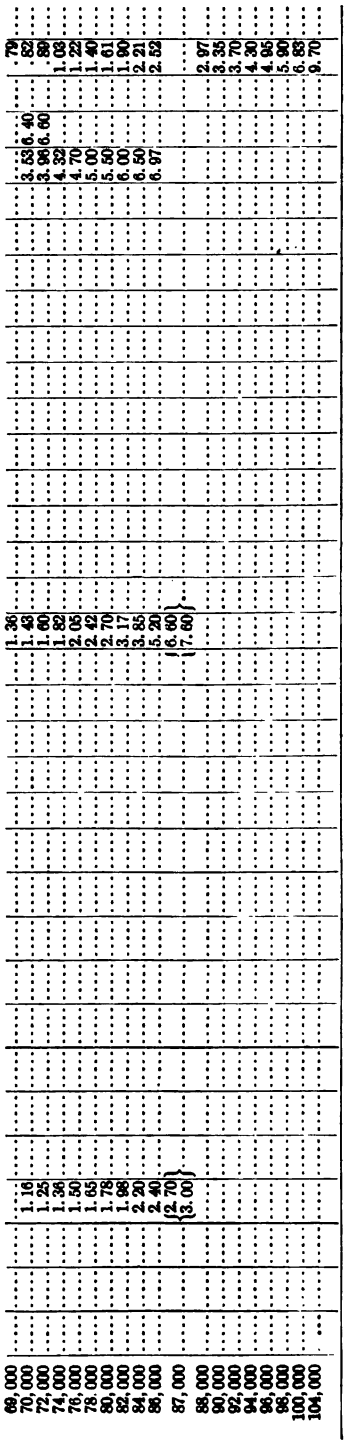
ELONGATION OF RODS, TAKEN ON MOVING HEAD OF TESTING MACHINE.

Applied loads.	No. of specimen.																																
	1.	1 w.	2.	2 w.	3.	3 w.	4.	4 w.	5.	5 w.	6.	6 w.	7.	7 w.	8.	8 w.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.
Pounds.	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*
0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
500	0.	0.	.01	.01	0.	0.	0.	.01	0.	0.	0.	0.	.01	0.	.01	.01	0.	0.	0.	0.	0.	0.	.01	.02	0.	0.	0.	.01	.01	0.	0.	.03	0.	.01	....
1,000	0.	0.	.01	.01	0.	.01	0.	.01	0.	.01	0.	0.	.01	.01	.01	.02	0.	.01	.01	.01	.01	.01	.02	.02	0.	.01	.01	.02	.01	.01	0.	.03	.01	.01	....
2,000	0.	0.	.02	.01	0.	.01	0.	.02	.01	.01	.01	0.	.02	.01	.02	.03	.01	.01	.02	.01	.01	.01	.03	.03	.01	.01	.01	.03	.01	.02	0.	.04	.01	.01	....
3,000	0.	0.	.03	.01	0.	.01	.01	.03	.01	.02	.01	.01	.03	.01	.03	.04	.01	.02	.03	.01	.02	.01	.04	.04	.01	.01	.02	.03	.02	.03	0.	.04	.01	.02	....
4,000	.01	.01	.04	.02	.01	.02	.01	.03	.01	.03	.02	.01	.03	.01	.04	.05	.01	.02	.03	.01	.02	.02	.05	.05	.02	.02	.02	.04	.02	.04	.01	.04	.01	.02	....
5,000	.01	.01	.05	.02	.01	.02	.02	.04	.02	.03	.02	.01	.04	.02	.05	.06	.01	.02	.04	.02	.02	.02	.06	.05	.02	.02	.03	.05	.03	.04	.01	.05	.02	.02	....
6,000	.02	.01	.05	.02	.01	.02	.02	.04	.03	.04	.03	.02	.05	.02	.06	.07	.02	.03	.04	.02	.03	.02	.07	.06	.02	.03	.03	.05	.03	.05	.01	.05	.02	.02	....
7,000	.02	.01	.05	.02	.02	.03	.03	.04	.04	.05	.04	.02	.05	.02	.07	.08	.02	.03	.04	.03	.04	.03	.08	.07	.03	.03	.04	.06	.04	.06	.02	.05	.03	.03	....
8,000	.03	.02	.06	.03	.02	.03	.03	.05	.04	.05	.04	.02	.06	.03	.08	.09	.02	.04	.05	.03	.04	.03	.09	.07	.03	.04	.05	.07	.04	.06	.02	.07	.03	.03	....
9,000	.03	.02	.06	.03	.02	.04	.04	.05	.05	.06	.05	.03	.07	.03	.08	.10	.03	.04	.06	.04	.05	.03	.10	.08	.04	.05	.06	.08	.04	.07	.02	.09	.03	.04	....
10,000	.04	.02	.07	.03	.03	.05	.06	.06	.05	.07	.06	.03	.08	.04	.09	.10	.03	.04	.07	.05	.05	.04	.10	.09	.04	.05	.07	.09	.05	.07	.03	.11	.04	.04	....
11,000	.04	.03	.07	.04	.03	.06	.05	.07	.06	.07	.06	.04	.09	.05	.10	.11	.04	.05	.09	.06	.06	.04	.10	.09	.04	.06	.07	.10	.06	.08	.03	.14	.05	.05	....
12,000	.05	.03	.08	.04	.04	.06	.06	.07	.06	.08	.07	.04	.09	.06	.10	.11	.04	.05	.10	.07	.07	.05	.11	.10	.05	.06	.07	.10	.06	.08	.03	.18	.09	.05	....
13,000	.07	.04	.08	.05	.05	.07	.06	.08	.07	.08	.07	.05	.10	.07	.10	.12	.05	.06	.10	.07	.07	.06	.11	.10	.05	.07	.08	.10	.07	.09	.04	.23	.11	.05	....
14,000	.07	.04	.09	.06	.05	.08	.07	.08	.08	.09	.07	.05	.10	.08	.10	.15	.19	.06	.10	.08	.07	.06	.12	.10	.06	.08	.08	.11	.07	.09	.04	.34	.13	.05	....
15,000	.08	.18	.09	.06	.06	.09	.08	.09	.12	.09	.08	.06	.10	.09	.11	.18	.20	.07	.11	.09	.08	.07	.12	.11	.06	.08	.09	.11	.08	.09	.04	.46	.18	.06	....
16,000	.08	.22	.09	.07	.07	.10	.08	.09	.19	.10	.08	.06	.11	.09	.12	.19	.21	.07	.11	.09	.08	.08	.13	.11	.07	.08	.09	.12	.08	.09	.05	.59	.20	.06	....
17,000	.09	.27	.10	.07	.07	.10	.09	.09	.21	.20	.08	.07	.11	.10	.15	.20	.22	.08	.12	.10	.09	.08	.17	.11	.07	.09	.09	.12	.09	.10	.05	.67	.22	.07	....
18,000	.29	.30	.10	.08	.08	.11	.09	.10	.25	.26	.09	.07	.15	.11	.18	.21	.25	.08	.13	.10	.09	.09	.19	.12	.08	.09	.10	.14	.09	.10	.06	.76	.26	.07	....
19,000	.33	.32	.10	.08	.09	.12	.09	.10	.28	.28	.09	.08	.18	.13	.20	.27	.27	.09	.15	.10	.10	.09	.20	.12	.08	.09	.10	.15	.09	.10	.06	.82	.31	.07	....
20,000	.38	.36	.10	.09	.10	.15	.10	.11	.30	.29	.10	.09	.20	.19	.22	.31	.29	.09	.18	.10	.10	.10	.22	.14	.08	.10	.10	.17	.09	.10	.07	.89	.42	.08	....
21,000	.41	.40	.10	.09	.10	.17	.10	.11	.34	.31	.10	.09	.22	.21	.25	.37	.30	.09	.19	.10	.10	.10	.30	.15	.08	.10	.10	.18	.10	.10	.07	.94	.54	.08	....
22,000	.44	.42	.10	.09	.11	.19	.11	.11	.38	.36	.10	.10	.25	.23	.29	.40	.32	.10	.20	.11	.11	.10	....	.17	.08	.10	.10	.19	.10	.10	.08	1.00	1.03	.08	....
23,000	.50	.47	.11	.09	.13	.20	.15	.12	.40	.39	.10	.10	.29	.28	.32	.46	.36	.10	.21	.11	.11	.10	....	.18	.09	.10	.10	.20	.10	.11	.08	1.07	....	.09	....
24,000	.55	.49	.11	.10	.17	.20	.18	.12	.48	.41	.11	.10	.31	.31	.42	.51	.40	.10	.22	.11	.11	.11	....	.18	.09	.11	.11	.21	.10	.11	.08	1.11	....	.09	....
25,000	.60	.51	.11	.10	.18	.21	.20	.15	.50	.45	.11	.10	.36	.33	.52	.63	.43	.10	.24	.12	.12	.11	....	.19	.09	.11	.11	.27	.10	.12	.09	1.15	....	.09	....
26,000	.66	.55	.11	.10	.20	.24	.25	.17	.52	.48	.12	.10	.39	.38	.90	1.00	.49	.10	.27	.12	.13	.12	....	.20	.10	.11	.11	.70	.11	.12	.09	1.18	....	.09	....
27,000	.70	.60	.12	.10	.21	.26	.29	.19	.55	.51	.12	.11	.41	.42	1.60	1.69	.55	.10	.30	.12	.14	.12	....	.20	.10	.12	.12	1.20	.11	.13	.09	1.21	....	.09	....
28,000	.80	.66	.12	.10	.22	.28	.72	.20	.58	.52	.13	.11	.49	.60	1.73	....	.66	.10	.31	.13	.70	.13	....	.21	.10	.12	.12	1.47	.12	.14	.09	1.23	....	.10	....
29,000	.....	.73	.12	.10	.23	.29	.80	.22	.60	.59	.13	.11	.60	....	2.05	.....	.....	.11	.32	.13	.84	.14	....	.22	.10	.13	.13	1.82	.13	{.16 / .21}	.09	1.26	....	.10	....
30,000	.....	.....	.13	.10	.28	.30	.90	.24	.63	.60	.14	.12	.80	....	2.70	.....	.....	.11	.38	.14	.90	.15	....	.25	.11	.14	.14	2.17	.18	.25	.10	1.29	....	.10	....
31,000	.....	.....	.13	.10	.30	.34	.....	.26	.....	.65	.15	.13	1.29	....	4.83	.....	.....	.11	.40	.15	....	.15	....	.31	.11	.16	.15	2.40	.21	.29	.10	1.32	....	.10	....
32,000	.....	.....	.14	.11	.31	.37	1.02	.28	.70	.69	.16	.13	.....	....	5.80	.....	.....	.12	.42	.16	1.01	.15	....	.47	.11	.17	.....	2.67	.21	.30	.10	1.35	....	.10	....
33,000	.....	.....	.15	.11	.33	.....	.....	.30	.....	.....	.16	.14	.....	....	.....	.....	.....	.12	.46	.17	.....	.16	....	1.09	.12	.18	.....	.....	.22	.31	.10	1.39	....	.10	....
34,000	.....	.....	.16	.11	.35	.41	1.19	.31	.77	.78	.16	.15	.....	....	.....	.....	.....	.13	.49	.18	1.17	.17	....	2.08	.12	.20	....	3.50	.25	.36	.10	1.41	....	.10	....

DETAILS OF TESTS—Continued.

ELONGATION OF RODS, TAKEN ON MOVING HEAD OF TESTING MACHINE—Continued.

Applied loads.	No. of specimen.																																		
	1.	1 w.	2.	2 w.	3.	3 w.	4.	4 w.	5.	5 w.	6.	6 w.	7.	7 w.	8.	8 w.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.
Pounds.	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*
35,000	.....	.....	.16	.11	.40	.80	.....	.33	.....	.....	.17	.16	.....	.....	.....	.....	.....	.13	.53	.19	.....	.17	.....	2.40	.13	.46	.....	4.98	.28	.43	.10	1.46	.....	.10	.....
36,000	.....	.....	.17	.12	.42	.....	1.38	.35	.85	.88	.17	.17	.....	.....	.....	.....	.....	.14	.....	.19	1.40	.18	.....	.....	.15	.....	.....	.....	.30	.....	{.11 .13}	1.50	.....	.11	.....
37,000	.....	.....	.17	.12	.....	.....	.....	.41	.....	.....	.18	.17	.....	.....	.....	.....	.....	.14	.....	.20	.....	.18	.....	.....	.17	.....	.....	.....	.32	.....	.17	1.52	.....	.11	.....
38,000	.....	.....	.18	.12	.50	.....	1.60	.43	.98	.99	.18	.18	.....	.....	.....	.....	.....	.15	.....	.20	1.59	.19	.....	.....	.24	.....	.....	.....	.35	.....	.18	1.57	.....	.12	.....
39,000	.....	.....	{.18 .30}	.13	.....	.....	.....	.....	.....	.....	.48	{.18 .60}	.....	.....	.....	.....	.....	.16	.....	.20	.....	.19	.....	.....	.....	.....	.....	.....	.39	.....	.18	1.61	.....	.12	.....
40,000	.....	.....	.34	.13	.58	.....	1.90	.47	.....	1.06	.52	.66	.....	.....	.....	.....	.....	.16	.....	.21	.....	.20	.....	.....	.....	.....	.....	.....	.47	.....	.19	1.65	.....	.12	.....
41,000	.....	.....	.37	.17	.....	.....	.....	.....	.....	.....	.57	.69	.....	.....	.....	.....	.....	.17	.....	.26	.....	.20	.....	.....	.....	.....	.....	.....	.....	.....	.20	1.70	.....	.13	.....
42,000	.....	.....	.40	.18	1.25	.....	2.16	.57	.....	1.19	.60	.70	.....	.....	.....	.....	.....	.18	.....	.28	.....	.21	.....	.....	.....	.....	.....	.....	.....	.....	.21	1.73	.....	.14	.....
43,000	.....	.....	.41	{.19 .40}	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.19	.....	.29	.....	.21	.....	.....	.....	.....	.....	.....	.....	.....	.23	.....	.....	.14	.....
44,000	.....	.....	.43	.41	.....	.....	2.70	.69	.....	1.35	.66	.78	.....	.....	.....	.....	.....	.19	.....	.30	.....	.22	.....	.....	.....	.....	.....	.....	.....	.....	.27	1.84	.....	.15	.....
45,000	.....	.....	.46	.42	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.19	.....	.31	.....	.23	.....	.....	.....	.....	.....	.....	.....	.....	.32	.....	.....	.16	.....
46,000	.....	.....	.49	.45	.....	.....	3.40	1.04	.....	1.52	.76	.85	.....	.....	.....	.....	.....	.20	.....	.40	.....	.24	.....	.....	.....	.....	.....	.....	.....	.....	.37	2.15	.....	.16	.....
47,000	.....	.....	.50	.48	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.20	.....	.50	.....	.26	.....	.....	.....	.....	.....	.....	.....	.....	.39	.....	.....	.17	.....
48,000	.....	.....	.52	.50	.....	.....	.....	.....	.....	.....	.86	.97	.....	.....	.....	.....	.....	.20	.....	1.20	.....	.27	.....	.....	.....	.....	.....	.....	.....	.....	.40	2.40	.....	.18	.....
49,000	.....	.....	.54	.51	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.20	.....	1.47	.....	.30	.....	.....	.....	.....	.....	.....	.....	.....	.41	.....	.....	.18	.....
50,000	.....	.....	.58	.52	.....	.....	.....	.....	.....	.....	.95	1.10	.....	.....	.....	.....	.....	.20	.....	1.78	.....	.30	.....	.....	.....	.....	.....	.....	.....	.....	.45	2.58	.....	.19	.....
51,000	.....	.....	.60	.55	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.21	.....	2.25	.....	.31	.....	.....	.....	.....	.....	.....	.....	.....	.48	.....	.....	.19	.....
52,000	.....	.....	.62	.59	.....	.....	.....	.....	.....	.....	1.10	1.20	.....	.....	.....	.....	.....	.21	.....	.....	.....	.32	.....	.....	.....	.....	.....	.....	.....	.....	.50	2.73	.....	.20	.....
53,000	.....	.....	.65	.60	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.22	.....	.....	.....	.35	.....	.....	.....	.....	.....	.....	.....	.....	.52	.....	.....	.20	.....
54,000	.....	.....	.....	.62	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.22	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.58	2.95	.....	.20	.....
55,000	.....	.....	.....	.65	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.24	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.60	.....	.....	.21	.....
56,000	.....	.....	.....	.68	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.25	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.68	3.15	.....	.22	.....
57,000	.....	.....	.....	.70	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.27	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.71	.....	.....	.30	.....
58,000	.....	.....	.....	.73	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.28	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.79	3.32	.....	.31	.....
59,000	.....	.....	.....	.76	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.43	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.88	.....	.....	.33	.....
60,000	.....	.....	.....	.79	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.49	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.02	3.50	.....	.30	.....
61,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.50	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.41	.....
62,000	.....	.....	.....	.83	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.52	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.33	3.75	.....	.50	.....
63,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.57	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.54	.....
64,000	.....	.....	.....	.90	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.66	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.45	4.32	.....	.59	.....
65,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.74	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.61	.....
66,000	.....	.....	.....	.99	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.80	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3.07	5.30	.....	.65	.....
67,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.89	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.70	.....
68,000	.....	.....	.....	1.08	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3.35	6.18	.....	.76	.....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BEHAVIOR OF BARS UNDER TESTS.

1. Elongated under 17,000 pounds tension from ″.09 to ″.18. Cracks opened at south end of concrete blocks. Under 18,000 pounds cracks opened at the end of concrete. Ultimate strength, 28,800 pounds tension. Clips with short liners.

1w. At 14,300 pounds tension rapid yielding occurred. At this time the elongation increased to ″.17 and a crack developed at one end. Crack developed at the other end under 18,000 pounds tension. Short liner clips.

2. Rapid yielding and cracks developed at 39,000 pounds tension. The elongation increased from ″.18 to ″.30 while under this load. The maximum resistance was reached at 83,000 pounds, at which time the elongation had reached a total of 3″.90. The larger part of the concrete fell from the rods immediately preceding the maximum load, the wire-rope clips and the twisted-steel wrapping of the core assumed an oblique position as the steel bars were pulled along. Short liner clips.

2w. Cracks developed at 41,000 pounds tension. Yielding at 41,000 pounds, which became very pronounced at 43,000 pounds. At 47,000 pounds transverse cracks in three places, one about 7″ from each end and one 18″ from end of concrete. Short liner clips.

3w. Elongated ″.99 at time maximum load was reached.

5. Elongation of specimen was 1″.6 at the time of reaching the maximum resistance.

5w. Rapid yielding occurred at 19,000 pounds.

6w. The twisted bars slipped under the clips as the tension on them was increased. The maximum load was attained at the time the clips at one end reached the end of the bar.

8. Scale started off one bar at 26,000 pounds tension. At 30,000 pounds tension the other bar stretched rapidly. At 31,000 pounds tension the bars had drawn from the concrete 1¼″ and 1⅛″ respectively, as shown at the ends of the concrete prism. At 31,800 pounds tension cracks first became visible in the concrete. Test discontinued at 39,500 pounds, at which time the elongation was 14″.12.

8w. At 26,000 pounds tension cracks developed in concrete and bars were drawn from the concrete at each end. Elongation increased from 1″.69 to 1″.90 under load below the maximum.

9. At 13,200 pounds tension rapid yielding. Elongation from ″.05 to ″.18 under this load. Three cracks developed at one end at 25,000 pounds tension. Other end cracked at 27,000 pounds tension.

10. At 39,000 pounds tension crack at one end. Rapid yielding at 58,800 pounds. Elongation now ″.41. Transverse crack at middle of length of concrete at 60,000 pounds.

13. Rapid yielding at 27,600 pounds, opening cracks in concrete. Ultimate resistance reached at 38,200 pounds. The concrete outside of the wire wrapping was detached and fell off in pieces.

14. A change in the rate of elongation occurred at 53,000 pounds tension, at first being gradual. At 57,000 pounds a more rapid rate was inaugurated, which thereafter continued.

16. At 32,800 pounds tension the bars began to scale, the elongation then being ″.71, which increased to 1″.02 under this load. At 34,000 pounds tension one bar pulled from the concrete about ¼″, measured at the end face of the prism. At 35,800 pounds the elongation was 3″.77, when the resistance dropped and further elongation occurred under reduced load.

17. Cracks at 37,000 pounds. Elongation increased in five minutes from ″.17 to ″.19. Clips with long liners.

19. Rapid yielding and ultimate resistance was reached at 31,000 pounds tension.

20. Scale starts off one bar at 27,000 pounds tension. Test discontinued when the elongation had reached 4″.98 pounds, the tension on the specimen then being 35,000 pounds.

21. The rod at one end of this specimen was bent before testing. It was partially straightened by means of a sledge. Rapid yielding and crack developed at 30,000 pounds.

22. Rapid yielding at 29,000 pounds. Cracks developed at 34,000 pounds. Maximum load 35,800 pounds. The load fell and elongation of the rods continued under 21,000 pounds, reaching a total movement of 1″.05.

23. Change in rate of elongation at 36,000 pounds tension. Cracks developed at 44,000 pounds tension. Elastic limit of 1½″ bars reached at 72,000 pounds total tension.

24. Scale starts off bars at 68,000 pounds tension. One clip fractured at 72,000 pounds tension on the rods.

25. Distance between 1½″ clips 22¾″. Rapid yielding at 12,000 pounds. Test discontinued at 22,000 pounds. Slip now 1″.03.
26. Two 1½″ round rods, ends not upset, clamped together by means of 8 1½″ Crosby wire-rope clips. Nuts set up with 33-inch wrench. Rapid yielding at 57,000 pounds tension. At 74,000 pounds further scaling of the rods went on. These rods were used in a previous test and were partially scaled at that time. Fractured second clip at 106,400 pounds tension.
27. After the first slip at 16,900 pounds tension the bars continued in their slipping movement under reduced loads until the U-shaped loops had moved over and rested against the sides of the casting, which formed the other part of the clip. A movement of ″.27 occurred in doing this, after which there was increased resistance against further slipping. When the load had advanced to 23,000 pounds one of the clip castings fractured across at the bolt holes.

    In the latter stages of the test the remaining clip held the bars against a pull of 26,600 pounds. The fractured casting was made of cast iron. The second clip, in which a crack was developed, was made of malleable iron.
28. Immediately after the first slipping of the bars occurred the loop of the middle clip fractured at the middle of the bend. The temporary reduction in resistance allowed the load to fall to about 21,000 pounds after first slip. From this minimum the resistance rose to 37,000 pounds when one of the outside clips of the three fractured in the casting. There was, however, a further increase in resistance, which reached a maximum of 44,300 pounds tension, at which time the total slipping of the bars was 3″.

STEEL BARS FOR LONG-CONTINUED LOADS ON CONCRETE COLUMNS.

OBSERVATIONS ON THE ELONGATIONS OF BARS FOR APPLYING LONG-CONTINUED LOADS TO CONCRETE COLUMNS.

TENSILE STRESSES APPLIED TO 1¼″ STEEL BARS, USED FOR APPLYING LONG-CONTINUED LOADS TO CONCRETE COLUMNS.

Length of bars over all, 8′ 8″.
Elongations measured on gauged lengths of 30″ each, established 30″ from the lower ends.
Weight of one rod, 35½ pounds.

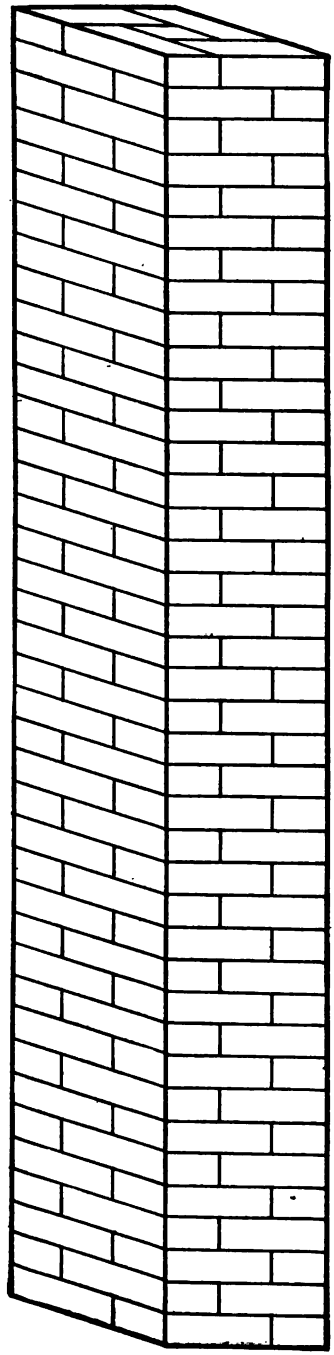
Bar No.	Diameter.	Sectional area.	Initial loading with 40,000 pounds total.		Elongations in gauged length of 30 inches, under total loads of tension of—																
			Extension.	Set.	1,000 lbs.	2,000 lbs.	3,000 lbs.	4,000 lbs.	5,000 lbs.	6,000 lbs.	8,000 lbs.	10,000 lbs.	12,000 lbs.	14,000 lbs.	16,000 lbs.	18,000 lbs.	20,000 lbs.	24,000 lbs.	28,000 lbs.	32,000 lbs.	36,000 lbs.
	Inches.	*Sq. in.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*
1...	1.25	1.227	.0340	.0003	.0013	.0022	.0032	.0042	.0052	.0062	.0080	.0096	.0113	.0131	.0147	.0163	.0179	.0209	.0243	.0275	.0308
2...	1.25	1.227	.0364	.0003	.0013	.0026	.0037	.0046	.0056	.0067	.0087	.0107	.0124	.0142	.0159	.0176	.0192	.0226	.0261	.0294	.0328
3...	1.25	1.227	.0347	.0022	.0011	.0019	.0028	.0036	.0045	.0054	.0070	.0087	.0104	.0121	.0137	.0152	.0168	.0201	.0233	.0266	.0299
4...	1.24	1.208	.0356	.0022	.0010	.0019	.0027	.0036	.0045	.0054	.0071	.0089	.0106	.0123	.0140	.0155	.0172	.0202	.0238	.0271	.0302
5...	1.24	1.208	.0341	.0011	.0009	.0018	.0026	.0034	.0043	.0052	.0070	.0089	.0104	.0122	.0139	.0154	.0170	.0202	.0235	.0268	.0300
6...	1.24	1.208	.0330	−.0005	.0008	.0016	.0025	.0034	.0042	.0051	.0069	.0086	.0105	.0121	.0138	.0154	.0169	.0203	.0235	.0269	.0303
7...	1.24+	1.208	.0326	0.	.0010	.0019	.0027	.0036	.0044	.0052	.0069	.0085	.0101	.0117	.0133	.0148	.0165	.0195	.0228	.0260	.0292
8...	1.24+	1.208	.0338	.0006	.0009	.0018	.0027	.0034	.0044	.0052	.0070	.0086	.0103	.0119	.0136	.0152	.0168	.0200	.0233	.0265	.0300
9...	1.24	1.208	.0350	.0010	.0012	.0020	.0030	.0039	.0047	.0056	.0073	.0090	.0107	.0124	.0141	.0158	.0175	.0206	.0242	.0273	.0306
10...	1.24+	1.208	.0330	.0002	.0009	.0017	.0025	.0033	.0042	.0050	.0068	.0084	.0101	.0118	.0133	.0149	.0165	.0198	.0230	.0264	.0298
11...	1.25	1.227	.0330	.0002	.0009	.0017	.0024	.0033	.0042	.0050	.0068	.0084	.0102	.0120	.0135	.0150	.0166	.0198	.0231	.0264	.0297
12...	1.25	1.227	.0335	.0001	.0010	.0019	.0028	.0037	.0045	.0055	.0071	.0089	.0107	.0123	.0139	.0155	.0170	.0203	.0237	.0270	.0302
13...	1.24	1.208	.0326	.0002	.0008	.0016	.0023	.0030	.0039	.0048	.0064	.0080	.0098	.0113	.0130	.0146	.0162	.0194	.0227	.0260	.0293
14...	1.25	1.227	.0343	.0012	.0010	.0019	.0027	.0036	.0044	.0054	.0071	.0087	.0106	.0120	.0138	.0153	.0169	.0200	.0233	.0265	.0298
15...	1.24	1.208	.0340	0.	.0009	.0018	.0029	.0038	.0046	.0055	.0073	.0091	.0108	.0125	.0141	.0157	.0172	.0206	.0240	.0274	.0305
16...	1.25+	1.227	.0332	.0009	.0009	.0018	.0027	.0035	.0044	.0053	.0069	.0084	.0103	.0118	.0133	.0150	.0165	.0197	.0229	.0262	.0294
17...	1.25+	1.227	.0346	.0014	.0011	.0020	.0028	.0037	.0046	.0055	.0072	.0089	.0106	.0122	.0139	.0154	.0170	.0203	.0236	.0268	.0300
18...	1.25−	1.227	.0351	.0014	.0009	.0018	.0027	.0036	.0045	.0054	.0072	.0091	.0108	.0126	.0142	.0158	.0174	.0206	.0241	.0274	.0310
19...	1.24+	1.208	.0342	.0006	.0009	.0018	.0026	.0036	.0045	.0054	.0072	.0090	.0108	.0125	.0141	.0156	.0171	.0204	.0238	.0273	.0304
20...	1.25−	1.227	.0334	.0010	.0010	.0018	.0026	.0034	.0043	.0051	.0068	.0084	.0102	.0118	.0135	.0150	.0166	.0196	.0230	.0262	.0295
21...	1.25+	1.227	.0340	.0022	.0008	.0017	.0024	.0032	.0040	.0048	.0064	.0083	.0099	.0116	.0132	.0147	.0162	.0193	.0226	.0258	.0289
22...	1.25−	1.227	.0333	0.	.0010	.0019	.0028	.0035	.0044	.0053	.0070	.0087	.0105	.0122	.0138	.0154	.0171	.0202	.0235	.0268	.0300
23...	1.25+	1.227	.0325	.0003	.0009	.0017	.0025	.0034	.0042	.0051	.0068	.0085	.0102	.0117	.0133	.0149	.0165	.0196	.0229	.0262	.0293
24...	1.25+	1.227	.0327	.0003	.0009	.0017	.0026	.0034	.0042	.0050	.0068	.0085	.0101	.0118	.0133	.0149	.0164	.0195	.0227	.0260	.0293

TENSILE STRESSES APPLIED TO 1¼″ STEEL BARS, USED FOR APPLYING LONG-CONTINUED LOADS TO CONCRETE COLUMNS—Continued.

Bar No.	Diameter.	Sectional area.	Initial loading with 40,000 pounds total.		Elongations in gauged length of 30 inches, under total loads of tension of—															
			Extension.	Set.	1,000 lbs.	2,000 lbs.	3,000 lbs.	4,000 lbs.	5,000 lbs.	6,000 lbs.	8,000 lbs.	10,000 lbs.	12,000 lbs.	14,000 lbs.	16,000 lbs.	18,000 lbs.	20,000 lbs.	24,000 lbs.	28,000 lbs.	32,000 lbs.	36,000 lbs.
	Inches.	*Sq. in.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch*	*Inch.*	*Inch.*
25...	1.25−	1.227	.0316	0.	.0010	.0018	.0026	.0033	.0040	.0050	.0065	.0081	.0098	.0114	.0130	.0146	.0160	.0191	.0222	.0255	.0286
26...	1.25−	1.227	.0327	0.	.0008	.0016	.0025	.0034	.0043	.0051	.0067	.0083	.0102	.0119	.0135	.0151	.0167	.0200	.0231	.0265	.0296
27...	1.24+	1.208	.0376	.0047	.0008	.0015	.0023	.0031	.0040	.0049	.0065	.0084	.0100	.0115	.0132	.0150	.0165	.0196	.0230	.0263	.0297
28...	1.25	1.227	.0352	.0024	.0009	.0017	.0026	.0034	.0043	.0051	.0068	.0085	.0103	.0120	.0136	.0151	.0166	.0199	.0230	.0264	.0297
29...	1.25+	1.227	.0329	.0009	.0010	.0018	.0026	.0033	.0043	.0051	.0067	.0084	.0100	.0117	.0132	.0148	.0162	.0193	.0226	.0258	.0289
30...	1.24−	1.208	.0376	.0039	.0009	.0017	.0025	.0034	.0042	.0052	.0070	.0087	.0105	.0122	.0139	.0155	.0169	.0204	.0236	.0271	.0304
31...	1.25	1.227	.0322	.0001	.0009	.0018	.0026	.0034	.0041	.0051	.0068	.0084	.0102	.0116	.0133	.0149	.0164	.0195	.0228	.0260	.0293
32...	1.24	1.208	.0374	.0040	.0009	.0017	.0026	.0035	.0044	.0052	.0069	.0086	.0102	.0121	.0137	.0152	.0169	.0201	.0235	.0268	.0302
33...	1.25−	1.227	.0367	.0042	.0009	.0017	.0026	.0033	.0042	.0051	.0067	.0084	.0101	.0117	.0132	.0149	.0164	.0196	.0229	.0261	.0295
34[a].	1.23+	1.188	.0357	.0030	.0009	.0017	.0026	.0034	.0042	.0051	.0066	.0085	.0101	.0118	.0134	.0149	.0166	.0197	.0231	.0262	.0296
35...	1.25	1.227	.0352	.0023	.0009	.0020	.0029	.0037	.0046	.0055	.0072	.0089	.0105	.0123	.0139	.0155	.0171	.0203	.0237	.0269	.0301
36...	1.25−	1.227	.0342	.0023	.0009	.0017	.0025	.0032	.0041	.0050	.0067	.0083	.0101	.0115	.0130	.0146	.0161	.0192	.0225	.0256	.0290
37...	1.25+	1.227	.0332	.0006	.0009	.0018	.0027	.0035	.0044	.0052	.0067	.0086	.0103	.0119	.0135	.0151	.0166	.0198	.0230	.0263	.0296
38...	1.24+	1.208	.0364	.0027	.0010	.0019	.0028	.0037	.0046	.0055	.0073	.0091	.0107	.0125	.0142	.0158	.0174	.0206	.0239	.0273	.0306
39...	1.23	1.188	.0349	.0025	.0009	.0018	.0027	.0035	.0044	.0052	.0070	.0086	.0103	.0121	.0137	.0152	.0167	.0199	.0231	.0264	.0297
40...	1.24	1.208	.0339	.0010	.0009	.0018	.0026	.0034	.0043	.0051	.0069	.0085	.0104	.0119	.0136	.0152	.0169	.0200	.0231	.0265	.0298

[a] Weld at end of 30″ gauged length.

BRICK PIERS.



Height, 8 feet.

No. 1694.

12″ FACE BRICK PIER.

Wire-cut bricks.
Built of 37 courses of brick, with hollow core.
Laid in cement mortar—1 part Alpha cement and 5 parts sand.
Age, 8 months 20 days.
Weight, 918 pounds = 136 pounds per cubic foot.
Height of pier, 96.30 inches.
Outside dimensions, 11″.89 × 11″.90 = 141.49 square inches.
Core, 4″.50 × 4.52″ = 20.34 square inches.
Net sectional area, 121.15 square inches.
Average thickness of joints, ″.30.
Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
12,115	100	0.	0.	Initial load. Loaded with 8,000 pounds before testing.
18,173	150	.0008	.0001	
24,230	200	.0018	.0002	
30,288	250	.0025	.0002	
36,345	300	.0035	.0002	
42,403	350	.0044	.0003	
48,460	400	.0054	.0003	
54,518	450	.0065	.0004	
60,575	500	.0074	.0005	
66,633	550	.0086	.0005	
72,690	600	.0094	.0005	E (100-600) = 2,809,000 pounds per square inch.
.....	600	.0096	.0005	
84,805	700	.0115	.0006	
96,920	800	.0138	.0008	
109,035	900	.0158	.0010	
121,150	1,000	.0181	.0011	E (600-1,000) = 2,469,000 pounds per square inch.
.....	600	.0104	.0011	
.....	600	.0104	.0011	
133,265	1,100	.0203	.0013	
145,380	1,200	.0227	.0015	
157,495	1,300	.0249	.0016	
169,610	1,400	.0274	.0019	
181,725	1,500	.0298	.0021	
.....	600	.0119	.0020	
.....	600	.0119	.0020	
193,840	1,600	.0324	.0024	
205,955	1,700	.0348	.0026	
218,070	1,800	.0374	.0029	
230,185	1,900	.0400	.0032	
242,300	2,000	.0426	.0035	E (1,000-2,000) = 2,262,000 pounds per square inch.
.....	600	.0140	.0033	
.....	600	.0140	.0034	
254,415	2,100	.0454	.0038	
266,530	2,200	.0483	.0043	
278,645	2,300	.0514	.0044	
290,760	2,400	.0543	.0050	
302,875	2,500	.0572	.0054	
.....	.....	.....	.0045	Set after rest of ½ hour.
.....	600	.0159	.0047	
.....	600	.0159	.0046	

No. 1694—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
314,990	2,600	.0603	.0055	
327,105	2,700	.0637	.....	
339,220	2,800	.0663	.....	
351,335	2,900	.0705	.0074	
363,450	3,000	.0770	.0093	Ultimate strength.
.....	600	.0223	.0091	
.....	600	.0222	.0091	

Developed longitudinal cracks along middle part of pier. The maximum stress was not again reached after applying 3,000 pounds load and releasing.

No. 1695.

12″ FACE BRICK PIER.

Dry-pressed bricks.
Built of 38 courses of brick, with hollow core.
Laid in cement mortar—1 part Alpha cement and 5 parts sand.
Age, 8 months 21 days.
Weight, 916 pounds = 136.9 pounds per cubic foot.
Height of pier, 95.65 inches.
Outside dimensions, 11″.83 × 11″.81 = 139.71 square inches.
Core, 4″.35 × 4″.35 = 18.92 square inches.
Net sectional area, 120.79 square inches.
Average thickness of joints, ″.30.
Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
12,079	100	0.	0.	Initial load. Loaded with 8,000 pounds before testing.
18,119	150	.0010	0.	
24,158	200	.0018	0.	
30,198	250	.0027	0.	
36,237	300	.0037	.0002	
42,277	350	.0045	.0004	
48,316	400	.0056	.0004	
54,356	450	.0067	.0005	
60,395	500	.0078	.0006	
66,435	550	.0089	.0007	
72,474	600	.0099	.0007	E (100–600) = 2,717,000 pounds per square inch.
.....	600	.0099	.0007	
84,553	700	.0120	.0009	
96,632	800	.0141	.0011	
108,711	900	.0164	.0012	
120,790	1,000	.0188	.0014	E (600–1,000) = 2,439,000 pounds per square inch.
.....	600	.0110	.0014	
.....	600	.0110	.0016	
132,869	1,100	.0210	.0017	
144,948	1,200	.0232	.0019	
157,027	1,300	.0255	.0021	
169,106	1,400	.0280	.0023	
181,185	1,500	.0301	.0026	
.....	600	.0127	.0026	
.....	600	.0127	.0025	
193,264	1,600	.0327	.0029	
205,343	1,700	.0350	.0031	
217,422	1,800	.0376	.0034	
229,501	1,900	.0401	.0037	
241,580	2,000	.0426	.0040	E (1,000–2,000) = 2,358,000 pounds per square inch.
.....	600	.0147	.0040	
.....	600	.0147	.0040	
253,659	2,100	.0451	.0044	
265,738	2,200	.0479	.0048	
277,817	2,300	.0507	.0052	
289,896	2,400	.0533	.0056	
301,975	2,500	.0561	.0060	
.....	600	.0175	.0058	
.....	600	.0173	.0059	

No. 1695—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
314,054	2,600	.0586	.0061	
326,133	2,700	.0616	.0068	
338,212	2,800	.0645	.0071	
350,291	2,900	.0675	.0078	Snapping sound.
362,370	3,000	.0704	.0084	E (2,000–3,000) = 2,137,000 pounds per square inch.
.....	600	.0207	.0083	
.....	600	.0206	.0083	
374,449	3,100	.0738	.0090	
386,528	3,200	.0769	.0095	
398,607	3,300	.0803	.0103	
410,686	3,400	.0840	.0110	
415,100	3,437	.....	.....	Ultimate strength.

Opened longitudinal cracks in lower half of pier.

No. 1698.

12" FACE BRICK PIER.

Dry pressed bricks.
Built of 39 courses of brick, with hollow core.
Laid in lime mortar with Portland cement added—1 part lime mortar and 1 part Alpha cement.
Age, 8 months 15 days.
Weight, 909 pounds = 133 pounds per cubic foot.
Height of pier, 96.60 inches.
Outside dimensions, 11".80 × 11".80 = 139.34 square inches.
Core, 4".11 × 4".14 = 17.02 square inches.
Net sectional area; 122.22 square inches.
Average thickness of joints, ".30.
Gauged length, 50".
Color of mortar in joints, nearly white.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
12,222	100	0.	0.	Initial load. Loaded with 8,000 pounds before testing.
18,333	150	.0013	0.	
24,444	200	.0028	.0003	
30,555	250	.0045	.0007	
36,666	300	.0061	.0010	
42,777	350	.0079	.0013	
48,888	400	.0095	.0016	
54,999	450	.0111	.0019	
61,110	500	.0128	.0023	
67,221	550	.0143	.0024	
73,332	600	.0160	.0026	E (100-600) = 1,866,000 pounds per square inch.
.....	600	.0162	.0029	
85,554	700	.0193	.0033	
97,776	800	.0225	.0039	
109,998	900	.0260	.0043	
122,220	1,000	.0293	.0050	E (600-1,000) = 1,835,000 pounds per square inch.
.....	600	.0194	.0050	
.....	600	.0193	.0050	
134,442	1,100	.0330	.0057	
146,664	1,200	.0365	.0064	
158,886	1,300	.0403	.0071	
171,108	1,400	.0441	.0079	
183,330	1,500	.0479	.0088	
.....	600	.0250	.0087	
.....	600	.0247	.0088	
195,552	1,600	.0521	.0097	
207,774	1,700	.0569	.0111	
219,996	1,800	.0615	.0124	
232,218	1,900	.0664	.0140	
244,440	2,000	.0718	.0160	E (1,000-2,000) = 1,587,000 pounds per square inch.
.....	600	.0338	.0159	
.....	600	.0339	.0160	
256,662	2,100	.0779	.0184	
268,884	2,200	.0836	.0205	Snapping sounds.
281,106	2,300	.....	.....	Ultimate strength.

Opened longitudinal cracks at middle of height of pier.

No. 1699.

12″ FACE BRICK PIER.

Dry pressed bricks.
Built of 35 courses of brick, with hollow core.
Laid in cement mortar—1 part Alpha cement and 5 parts sand.
Age, 8 months 18 days.
Weight, 926 pounds = 137.3 pounds per cubic foot.
Height of pier, 97.25 inches.
Outside dimensions, 11″.78 × 11″.65 = 137.24 square inches.
Core, 4″.18 × 4″.20 = 17.56 square inches.
Net sectional area, 119.68 square inches.
Wide joints, average thickness, ″.58.
Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
11,968	100	0.	0.	Initial load. Loaded with 8,000 pounds before testing.
17,952	150	.0015	.0006	
23,936	200	.0028	.0009	
29,920	250	.0040	.0012	
35,904	300	.0053	.0014	
41,888	350	.0063	.0017	
47,872	400	.0075	.0018	
53,856	450	.0087	.0020	
59,840	500	.0100	.0023	
65,824	550	.0110	.0025	
71,808	600	.0121	.0026	E (100–600) = 2,632,000 pounds per square inch.
.....	600	.0123	.0027	
83,776	700	.0144	.0028	
95,744	800	.0168	.0030	
107,712	900	.0191	.0035	
119,680	1,000	.0217	.0038	E (600–1,000) = 2,381,000 pounds per square inch.
.....	600	.0139	.0038	
.....	600	.0137	.0038	
20,000	167	.....	.....	Load left on pier.
17,500	146	.....	.....	Load found on pier after 16 hours.
.....	100	.....	.0026	
.....	600	.0126	.0028	
.....	600	.0126	.0028	
131,648	1,100	.0238	.0037	
143,616	1,200	.0267	.0043	
155,584	1,300	.0292	.0047	
167,552	1,400	.0318	.0050	
179,520	1,500	.0345	.0055	
.....	600	.0163	.0055	
.....	600	.0164	.0055	
191,488	1,600	.0370	.0060	
203,456	1,700	.0400	.0064	
215,424	1,800	.0430	.0070	
227,392	1,900	.0460	.0075	
239,360	2,000	.0489	.0079	E (1,000–2,000) = 2,165,000 pounds per square inch.
.....	600	.0196	.0080	
.....	600	.0196	.0079	
251,328	2,100	.0517	.0085	
263,296	2,200	.0547	.0090	
275,264	2,300	.0575	.0096	
287,232	2,400	.0610	.0103	
299,200	2,500	.0640	.0109	

No. 1699—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
.....	600	.0235	.0109	
.....	600	.0234	.0106	
311,168	2,600	.0677	.0116	
323,136	2,700	.0711	.0123	
335,104	2,800	.0750	.0133	
347,072	2,900	.0790	.0145	
359,040	3,000	.0821	.0159	E (2,000-3,000)=1,984,000 pounds per square inch.
.....	600	.0300	.0158	
.....	600	.0296	.0156	
371,008	3,100	.0873	.0170	Snapping sound.
384,000	3,209	.....	.....	Ultimate strength.

Opened longitudinal cracks at middle of height of pier.

No. 1697.

12″ FACE BRICK PIER.

Repressed bricks.
Built of 34 courses of brick, with hollow core.
Laid in cement mortar—1 part Alpha cement and 5 parts sand.
Age, 8 months 20 days.
Weight, 896 pounds = 123.7 pounds per cubic foot.
Height of pier, 96.70 inches.
Outside dimensions, 12″.24 × 12″.15 = 148.72 square inches.
Core, 4″.33 × 4″.48 = 19.40 square inches.
Net sectional area, 129.32 square inches.
Wide joints, average thickness, ″.55.
Gauged length, 50″.
Laid with wide bed joints; dry end joints.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
12,932	100	0.	0.	Initial load. Loaded with 8,000 pounds before testing.
19,398	150	.0029	.0005	
25,864	200	.0056	.0008	
32,330	250	.0085	.0013	
38,796	300	.0115	.0016	
45,262	350	.0145	.0021	
51,728	400	.0176	.0024	
58,194	450	.0206	.0027	
64,660	500	.0236	.0031	
71,126	550	.0267	.0035	
77,592	600	.0298	.0039	E (100–600) = 965,000 pounds per square inch.
.....	600	.0300	.0040	
90,524	700	.0360	.0046	
103,456	800	.0422	.0052	
116,388	900	.0501	.0071	
129,320	1,000	.0560	.0075	E (600–1,000) = 885,000 pounds per square inch.
.....	600	.0359	.0075	
.....	600	.0359	.0075	
142,252	1,100	.0628	.0083	
155,184	1,200	.0696	.0093	
168,116	1,300	.0766	.0103	
181,048	1,400	.0848	.0119	
193,980	1,500	.0921	.0130	Snapping sounds.
.....	600	.0453	.0130	
.....	600	.0450	.0130	
206,912	1,600	.1006	.0151	
218,500	1,690	.....	.....	Ultimate strength.

Opened longitudinal cracks at middle of length of pier.

No. 1693.

12" COMMON BRICK PIER.

Hard, sand-struck brick from New England Brick Company's yard, West Cambridge, Mass.

Built of 35 courses of brick, with hollow core.

Laid in cement mortar—1 part Alpha cement and 5 parts sand.

Age, 8 months 20 days.

Weight, 815 pounds = 132.5 pounds per cubic foot.

Height of pier, 95.45 inches.

Outside dimensions, 11".50 × 11".57 = 133.06 square inches.

Core, 4".49 × 4".85 = 21.78 square inches.

Net sectional area, 111.28 square inches.

Wide joints, average thickness, ".60.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
11,128	100	0.	0.	Initial load. Loaded with 5,000 pounds before testing.
16,692	150	.0013	.0003	
22,256	200	.0025	.0004	
27,820	250	.0039	.0006	
33,384	300	.0050	.0007	
38,948	350	.0063	.0010	
44,512	400	.0076	.0011	
50,076	450	.0089	.0013	
55,640	500	.0102	.0015	
61,204	550	.0114	.0018	
66,768	600	.0129	.0019	E (100-600) = 2,273,000 pounds per square inch.
.....	600	.0129	.0019	
77,896	700	.0154	.0021	
89,024	800	.0181	.0025	
100,152	900	.0210	.0028	
111,280	1,000	.0238	.0035	Snapping sound. E (600 - 1,000) = 2,151,000 pounds per square inch.
.....	600	.0150	.0033	
.....	600	.0150	.0033	
20,000	.....	.....	.....	Load left on pier.
18,000	.....	.....	.....	Load found on pier after 40 hours.
.....	100	.....	.0041	
.....	600	.0156	.0043	
.....	600	.0160	.0043	
122,408	1,100	.0279	.0052	
133,536	1,200	.0312	.0058	
144,664	1,300	.0343	.0063	
155,792	1,400	.0377	.0068	
166,920	1,500	.0413	.0077	
.....	600	.0210	.0078	
.....	600	.0209	.0077	
178,048	1,600	.0449	.0085	
189,176	1,700	.0487	.0093	
200,304	1,800	.0526	.0105	
211,432	1,900	.0570	.0118	
222,560	2,000	.0620	.0135	E (1,000-2,000) = 1,773,000 pounds per square inch.
.....	600	.0285	.0133	
.....	600	.0283	.0133	
233,688	2,100	.0677	.0154	Cracks developed in three courses in upper part of pier.
244,816	2,200	.....	.0214	Ultimate strength.

Opened longitudinal cracks in upper half of pier. Gradual failure occurred while the maximum stress was acting. This load was released and set determined. Upon reapplication of load the pier continued to yield under 234,000 pounds, increasing the size and number of the cracks.

No. 1702.

12" COMMON BRICK PIER.

Light hard, sand struck brick from New England Brick Company's yard, West Cambridge, Mass.
Built of 33 courses of brick, with hollow core.
Laid in cement mortar—1 part Alpha cement and 5 parts sand.
Age, 8 months 19 days.
Weight, 800 pounds = 116.7 pounds per cubic foot.
Height of pier, 97.20 inches.
Outside dimensions, 12".07 × 12".10 = 146.05 square inches.
Core, 4".78 × 4".97 = 23.76 square inches.
Net sectional area, 122.29 square inches.
Wide joints, average thickness, ".60.
Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
12,229	100	0.	0.	Initial load. Loaded with 8,000 pounds before testing.
18,344	150	.0028	.0006	
24,458	200	.0058	.0010	
30,573	250	.0090	.0015	
36,687	300	.0120	.0018	
42,802	350	.0150	.0022	
48,916	400	.0180	.0026	
55,031	450	.0210	.0030	
61,145	500	.0241	.0034	
67,260	550	.0273	.0036	
73,374	600	.0305	.0040	E (100–600) = 943,000 pounds per square inch.
.....	600	.0307	.0043	
85,603	700	.0366	.0049	
97,832	800	.0427	.0054	
110,061	900	.0490	.0060	Snapping sound.
122,290	1,000	.0556	.0067	E (600–1,000) = 893,000 pounds per square inch.
.....	600	.0353	.0067	
.....	600	.0353	.0067	
134,519	1,100	.0623	.0074	
146,748	1,200	.0688	.0082	
158,977	1,300	.0757	.0090	
171,206	1,400	.0830	.0100	
183,435	1,500	.0900	.0109	E (1,000–1,500) = 828,000 pounds per square inch.
.....	600	.0421	.0109	
.....	600	.0421	.0109	
195,664	1,600	.0970	.0118	
207,893	1,700	.1058	.0135	
220,122	1,800	.1140	.0146	
228,100	1,865	.....	.....	Ultimate strength.

Opened longitudinal cracks in lower half of pier.

No. 1700.

12″ COMMON BRICK PIER.

Hard, sand struck brick from New England Brick Company's yard, East Brookfield, Mass.
Built of 37 courses of brick, with hollow core.
Laid in cement mortar—1 part cement and 1 part sand.
Age, 8 months 12 days.
Weight, 794 pounds = 118.6 pounds per cubic foot.
Height of pier, 95.30 inches.
Outside dimensions, 12″.20 × 12″.08 = 147.38 square inches.
Core, 4″.85 × 5″.38 = 26.09 square inches.
Net sectional area, 121.29 square inches.
Average thickness of joints, ″.33.
Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
12,129	100	0.	0.	Initial load. Loaded with 8,000 pounds before testing.
18,194	150	.0022	.0004	
24,258	200	.0048	.0008	
30,323	250	.0071	.0013	
36,387	300	.0098	.0016	
42,452	350	.0123	.0020	
48,516	400	.0149	.0022	
54,581	450	.0175	.0026	
60,645	500	.0200	.0028	
66,710	550	.0228	.0032	
72,774	600	.0252	.0035	E (100–600) = 1,152,000 pounds per square inch.
.....	600	.0254	.0038	
84,903	700	.0307	.0045	
97,032	800	.0354	.0049	
109,161	900	.0406	.0054	
121,290	1,000	.0458	.0059	E (600–1,000) = 1,099,000 pounds per square inch.
.....	600	.0293	.0060	
.....	600	.0294	.0060	
133,419	1,100	.0516	.0066	
145,548	1,200	.0568	.0073	
157,677	1,300	.0622	.0079	
169,806	1,400	.0667	.0087	
181,935	1,500	.0735	.0094	E (1,000–1,500) = 1,033,000 pounds per square inch.
.....	600	.0351	.0093	
.....	600	.0350	.0093	
194,064	1,600	.0794	.0102	Snapping sounds.
206,193	1,700	.0851	.0110	
218,322	1,800	.0919	.0121	
230,451	1,900	.0985	.0133	
255,400	2,106	.....	.....	Ultimate strength.

Opened longitudinal cracks and partially crushed bricks in middle part of pier. Frequent snapping sounds were heard after the loads had reached 1,600 pounds per square inch.

No. 1701.

12″ COMMON BRICK PIER.

Hard, sand struck brick from New England Brick Company's yard, East Brookfield, Mass.

Built of 37 courses of brick, with hollow core.

Laid in lime mortar with Portland cement added—1 part lime mortar and 1 part Alpha cement. The lime mortar was composed of 1 part lime and 3 parts sand.

Age, 8 months 15 days.

Weight, 773 pounds = 112.8 pounds per cubic foot.

Height of pier, 96.12 inches.

Outside dimensions, 12″.22 × 12″.12 = 148.11 square inches.

Core, 4″.98 × 5″.02 = 25 square inches.

Net sectional area, 123.11 square inches.

Average thickness of joints, ″.33.

Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
12,311	100	0.	0.	Initial load. Loaded with 7,000 pounds before testing.
18,467	150	.0036	.0009	
24,622	200	.0071	.0016	
30,778	250	.0106	.0024	
36,933	300	.0150	.0044	
43,089	350	.0186	.0053	
49,244	400	.0220	.0058	
55,400	450	.0257	.0065	
61,555	500	.0291	.0070	
67,711	550	.0329	.0078	
73,866	600	.0365	.0084	E (100–600) = 890,000 pounds per square inch.
.....	600	.0370	.0088	
86,177	700	.0434	.0096	
98,488	800	.0508	.0111	
110,799	900	.0583	.0127	
123,110	1,000	.0662	.0144	E (600–1,000) = 844,000 pounds per square inch.
.....	600	.0460	.0146	
.....	600	.0460	.0146	
135,421	1,100	.0746	.0166	Snapping sounds.
147,732	1,200	.0827	.0189	
160,043	1,300	.0917	.0209	
172,354	1,400	.1005	.0238	
187,500	1,523	.....	.....	Ultimate strength.

Opened cracks near middle of height of pier.

No. 1704.

12" COMMON BRICK PIER.

Light hard, sand-struck brick from New England Brick Company's yard, East Brookfield, Mass.
Built of 36 courses of brick, with hollow core.
Laid in cement mortar—1 part Alpha cement and 7 parts sand.
Age, 8 months 13 days.
Weight, 758 pounds = 108.5 pounds per cubic foot.
Height of pier, 96.12 inches.
Outside dimensions, 12".20 × 12".18 = 148.60 square inches.
Core, 4".79 × 4".82 = 23.09 square inches.
Net sectional area, 125.51 square inches.
Average thickness of joints, ".35.
Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
12,551	100	0.	0.	Initial load. Loaded with 8,000 pounds before testing.
18,827	150	.0033	.0007	
25,102	200	.0065	.0011	
31,378	250	.0099	.0016	
37,653	300	.0130	.0020	
43,929	350	.0164	.0024	
50,204	400	.0200	.0029	
56,480	450	.0234	.0032	
62,755	500	.0268	.0037	
69,031	550	.0302	.0039	
75,306	600	.0338	.0043	Snapping sound. E (100–600) = 847,000 pounds per square inch.
.....	600	.0340	.0045	
87,857	700	.0401	.0050	
100,408	800	.0468	.0051	
107,000	853	.....	.....	Ultimate strength.

Bricks in lower courses crushed.

No. 1703.

12" COMMON BRICK PIER.

Hard, sand-struck brick from New England Brick Company's yard, Mechanicsville, N. Y.

Built of 38 courses of brick, with hollow core.

Laid in lime mortar with Portland cement added—1 part lime mortar and 1 part Alpha cement. The lime mortar was composed of 1 part lime and 3 parts sand.

Age, 8 months 16 days.

Weight, 726 pounds = 105.6 pounds per cubic foot.

Height of pier, 97.25 inches.

Outside dimensions, 11".97 × 12".06 = 144.36 square inches.

Core, 4".61 × 4".85 = 22.36 square inches.

Net sectional area, 122 square inches.

Average thickness of joints, ".30.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
12,200	100	0.	0.	Initial load. Loaded with 7,000 pounds before testing.
18,300	150	.0022	.0004	
24,400	200	.0047	.0009	
30,500	250	.0072	.0015	
36,600	300	.0097	.0019	
42,700	350	.0122	.0023	
48,800	400	.0148	.0028	
54,900	450	.0174	.0033	
61,000	500	.0200	.0037	
67,100	550	.0227	.0041	
73,200	600	.0253	.0045	E (100–600) = 1,202,000 pounds per square inch.
.....	600	.0256	.0046	
85,400	700	.0305	.0051	
97,600	800	.0357	.0059	
109,800	900	.0413	.0068	
122,000	1,000	.0470	.0078	E (600–1,000) = 1,087,000 pounds per square inch.
.....	600	.0306	.0078	
.....	600	.0305	.0078	
134,200	1,100	.0525	.0085	
146,400	1,200	.0590	.0098	Snapping sounds.
158,600	1,300	.0649	.0110	
170,800	1,400	.0710	.0119	
183,000	1,500	.0782	.0135	E (1,000–1,500) = 980,000 pounds per square inch.
.....	600	.0395	.0134	
.....	600	.0303	.0131	
185,100	1,517	.....	.....	Ultimate strength.

Opened cracks and bricks crushed in lower half of pier.

No. 1696.

12" COMMON BRICK PIER.

Hard, sand-struck brick from New England Brick Company's yard, Mechanicsville, N. Y.
Built of 33 courses of brick, with hollow core.
Laid in cement mortar—1 part Alpha cement and 5 parts sand.
Age, 8 months 18 days.
Weight, 723 pounds = 108.2 pounds per cubic foot.
Height of pier, 95.55 inches.
Outside dimensions, 12".00 × 11".96 = 143.52 square inches.
Core, 4".71 × 4".84 = 22.80 square inches.
Net sectional area, 120.72 square inches.
Wide joints, average thickness, ".55.
Gauged length, 50".
Laid with wide bed joints; dry end joints.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
12,072	100	0.	0.	Initial load. Loaded with 9,000 pounds before testing.
18,108	150	.0036	.0013	
24,144	200	.0073	.0024	
30,180	250	.0104	.0034	
36,216	300	.0138	.0043	
42,252	350	.0170	.0052	
48,288	400	.0203	.0059	
54,324	450	.0237	.0068	
60,360	500	.0270	.0075	
66,396	550	.0306	.0084	
72,432	600	.0351	.0101	E (100-600) = 1,000,000 pounds per square inch.
.....	600	.0355	.0102	
84,504	700	.0413	.0111	
96,576	800	.0485	.0126	Snapping sounds.
108,648	900	.0560	.0145	
120,720	1,000	.0640	.0175	E (600-1,000) = 930,000 pounds per square inch.
.....	600	.0458	.0167	
.....	600	.0456	0163	
132,792	1,100	.0729	.0189	
144,864	1,200	.0819	.0212	
147,200	1,219	.....	.....	Ultimate strength.

Failed in the lower half, developing longitudinal cracks and crushing the individual bricks.

No. 1708.

12" SAND-LIME BRICK PIER.

Sand-lime brick; material from the National Association of Manufacturers of Sand-Lime Products, Wilmington, Del.
Built of 37 courses of brick, with solid core.
Laid in cement mortar—1 part Alpha cement and 3 parts sand.
Age, 3 months 10 days.
Weight, 967 pounds = 111.6 pounds per cubic foot.
Height of pier, 95 inches.
Sectional area, 12".57 × 12".53 = 157.50 square inches.
Average thickness of joints, ".30.
Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
15,750	100	0.	0.	Initial load. Loaded with 10,000 pounds before testing.
23,625	150	.0017	0.	
31,500	200	.0038	.0004	
39,375	250	.0060	.0010	
47,250	300	.0083	.0015	
55,125	350	.0109	.0022	
63,000	400	.0134	.0028	
70,875	450	.0160	.0033	
78,750	500	.0190	.0040	
86,625	550	.0216	.0047	
94,500	600	.0244	.0051	E (100-600) = 1,295,000 pounds per square inch.
.....	600	.0250	.0055	
110,250	700	.0306	.0067	
126,000	800	.0376	.0086	
141,750	900	.0458	.0112	
157,500	1,000	.0554	.0134	E (600-1,000) = 881,000 pounds per square inch.
.....	600	.0392	.0144	
.....	600	.0391	.0145	
170,200	1,081	.....	.....	Ultimate strength.

Opened longitudinal cracks in the lower half of the pier.

No. 1709.

12" SAND-LIME BRICK PIER.

Sand-lime brick; material from the National Association of Manufacturers of Sand-Lime Products, Wilmington, Del.
Built of 38 courses of brick, with solid core.
Laid in lime mortar—1 part lime and 3 parts sand.
Age, 3 months 17 days.
Weight, 921 pounds = 107.9 pounds per cubic foot.
Height of pier, 94.25 inches.
Sectional area, 12".52 × 12".49 = 156.37 square inches.
Average thickness of joints, ".21.
Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
15,637	100	0.	0.	Initial load. Loaded with 9,000 pounds before testing.
23,456	150	.0140	.0110	
31,274	200	.0383	.0309	
39,093	250	.0637	.0519	
46,911	300	.0898	.0736	
54,730	350	.1187	.0970	
62,548	400	.1504	.1245	E (100-400) = 579,000 pounds per square inch.
70,367	450	.1960	.1640	Ultimate strength.

Bricks cracked in lower courses. Opened longitudinal cracks in the lower half of the pier.

No. 1710.

12″ SAND-LIME BRICK PIER.

Sand-lime brick; material from the National Association of Manufacturers of Sand-Lime Products, Wilmington, Del.
Built of 39 courses of brick, with solid core.
Laid in neat Portland cement, Alpha brand.
Age, 3 months 19 days.
Weight, 971 pounds = 113.4 pounds per cubic foot.
Height of pier, 95.40 inches.
Sectional area, 12″.46 × 12″.45 = 155.13 square inches.
Average thickness of joints, ″.20.
Gauged length, 50″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
15,513	100	0.	0.	Initial load. Loaded with 10,000 pounds before testing.
23,270	150	.0019	.0004	
31,026	200	.0040	.0009	
38,783	250	.0062	.0014	
46,539	300	.0083	.0018	
54,296	350	.0104	.0025	
62,052	400	.0125	.0029	
69,809	450	.0146	.0032	
77,565	500	.0168	.0035	
85,322	550	.0189	.0040	
93,078	600	.0209	.0043	E (100–600) = 1,506,000 pounds per square inch.
.....	600	.0210	.0045	
108,591	700	.0248	.0049	
124,104	800	.0294	.0057	
139,617	900	.0341	.0067	
155,130	1,000	.0386	.0076	E (600–1,000) = 1,389,000 pounds per square inch.
.....	600	.0260	.0076	
.....	600	.0259	.0076	
170,643	1,100	.0443	.0087	
186,156	1,200	.0503	.0103	
201,669	1,300	.0581	.0128	
217,182	1,400	.0670	.0153	Ultimate strength.

Opened longitudinal cracks in the lower half of the pier.

TABULATION OF COMPRESSION TESTS OF BRICK PIERS.

Nominal dimensions, 12″ × 12″ × 8 feet high.
Piers laid in neat Portland cement, cement mortar, and lime mortar.
Alpha Portland cement used.

No. of test.	Description of bricks.	Pier laid in—	Age.		Weight per cubic foot.	Net sectional area.	Compressive strength.		Moduli of elasticity between loads per square inch of—			Permanent set on gauged length of 50″ after loads in pounds per square inch of—		
							Total.	Per square inch.	100 and 600.	600 and 1,000.	1,000 and 2,000.	600.	1,000.	2,000.
			Mos.	*Days.*	*Pounds.*	*Sq. inch.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds*	*Pounds.*	*Inch.*	*Inch.*	*Inch.*
1694	Wire-cut bricks	1 cement, 5 sand.	8	20	136.0	121.15	363,450	3,000	2,809,000	2,469,000	2,262,000	.0005	.0011	.0035
1695	Dry-pressed bricks	.....do.....	8	21	136.9	120.79	415,100	3,437	2,717,000	2,439,000	2,358,000	.0007	.0014	.0040
1698	.....do.....	1 cement, 1 lime mortar.	8	15	133.0	122.22	281,106	2,300	1,896,000	1,835,000	1,587,000	.0026	.0050	.0160
[a] 1699	.....do.....	1 cement, 5 sand.	8	18	137.3	119.68	384,000	3,209	2,632,000	2,381,000	2,165,000	.0026	.0038	.0079
[a] 1697	Repressed bricks	.....do.....	8	20	123.7	129.32	218,500	1,690	965,000	885,000	.....	.0039	.0075	.....
[a] 1693	Hard, sand-struck, West Cambridge, Mass.	.....do.....	8	20	132.5	111.28	244,816	2,200	2,273,000	2,151,000	1,773,000	.0019	.0035	.0135
[a] 1702	Light-hard, sand-struck, West Cambridge, Mass.	.....do.....	8	19	116.7	122.29	228,100	1,865	943,000	893,000	.....	.0040	.0067	.....
1700	Hard, sand-struck, East Brookfield, Mass.	1 cement, 1 sand.	8	12	118.6	121.29	255,400	2,106	1,152,000	1,099,000	.....	.0035	.0059	.....
1701	.....do.....	1 cement, 1 lime mortar.	8	15	112.8	123.11	187,500	1,523	890,000	844,000	.....	.0084	.0144	.....
1704	Light-hard, sand-struck, East Brookfield, Mass.	1 cement, 7 sand.	8	13	108.5	125.51	107,000	853	847,000	.....	.....	.0043	.....	.....
1703	Hard, sand-struck, Mechanicsville, N. Y.	1 cement, 1 lime mortar.	8	16	105.6	122.00	185,100	1,517	1,202,000	1,087,000	.....	.0045	.0078	.....
[a] 1696	.....do.....	1 cement, 5 sand.	8	18	108.2	120.72	147,200	1,219	1,000,000	930,000	.....	.0101	.0175	.....
1708	Sand-lime bricks	1 cement, 3 sand.	3	10	111.6	157.50	170,200	1,081	1,295,000	881,000	.....	.0051	.0134	.....
1709	.....do.....	1 lime, 3 sand....	3	17	107.9	156.37	70,367	450	.....	.....	.....	.....	.....	.....
1710	.....do.....	Neat cement....	3	19	113.4	155.13	217,182	1,400	1,506,000	1,389,000	.....	.0043	.0076	.....

[a] Laid with wide bed joints," .55 to ".60 thick.

COMPRESSION TESTS OF MORTAR CUBES.

These cubes represent the mortar used in brick piers Nos. 1698, 1701, and 1703.

Composition: Lime mortar, 1; Alpha-Portland cement, 1. The lime mortar was made of 1 part lime and 1 part sand.

Compressed surfaces faced with neat Portland cement.

Age, 9 months.

CUBES TESTED IN ORDINARY DRY STATE.

Marks.	Dimensions.			Sectional area.	First crack.	Compressive strength.	
	Height.	Compressed surface.				Total.	Per square inch.
	Inches.	*Inches.*	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*
1.....	5.99	6.07	5.98	36.30	68,100	77,100	2,120
2.....	6.00	6.04	6.03	36.42	71,200	82,100	2,250
3.....	6.03	6.00	6.03	36.18	57,200	57,200	1,580

CUBES TESTED IN A WET STATE, AFTER AN IMMERSION OF 9 DAYS IN WATER.

4.....	6.03	6.07	5.98	36.30	63,600	63,600	1,750
5.....	6.05	6.03	5.98	36.06	69,300	69,300	1,920
6.....	6.00	6.08	5.98	36.36	62,900	62,900	1,730

ABSORPTION TESTS OF CUBES NOS. 4, 5, AND 6.

Marks.	Weights, dry.	Weights, wet, after 9 days' submersion.	Gain.	Absorption.	
				By weight.	By volume.
	Lbs. oz.	*Lbs. oz.*	*Lbs. oz.*	*Per cent.*	*Per cent.*
4.....	14 13.5	16 4.0	1 6.5	9.5	17.8
5.....	15 2.5	16 5.5	1 3.0	7.8	15.1
6.....	14 12.5	16 2.0	1 5.5	9.1	17.1

BRICKS.

BRICKS.

TESTS OF MATERIAL COLLECTED AT THE LOUISIANA PURCHASE EXPOSITION, ST. LOUIS, MO., 1904.

Time of immersion in water: Bricks, 1_1 to 14_3, 16 days; 16_1 to 44_{17}, 17 days; 46_1 to 51_6, 14 days; 51_{11} to 70_6, 15 days.

Marks.	From—	Description.	Weight.		Absorption.			Dimensions.		Sectional area.	First crack.	Compressive strength.	
			Dry.	Wet.	Total.	By weight.	By volume.	Height.	Compressed surface.			Total.	Per square inch.
			Lbs. oz.	*Lbs. oz.*	*Oz.*	*Per ct.*	*Per ct.*	*In.*	*In. In.*	*Sq. in.*	*Pounds.*	*Pounds.*	*Lbs.*
1_1	J. D. Carbaugh, Fort Smith, Ark.	Red, sand-lime brick	5 2.50	5 15.50	13.00	15.8	27.4	2.43	4.07 8.29	33.74	187,000	196,100	5,812
1_2	do	do	5 0.50	5 13.75	13.25	16.4	28.1	2.43	4.06 8.27	33.58	179,900	193,200	5,753
1_3	do	do						2.43	4.07 8.29	33.74	146,000	179,600	5,323
1_4	do	do						2.44	4.06 8.29	33.66	175,000	180,500	5,362
1_5	do	do						2.44	4.06 8.28	33.62	192,000	204,000	6,068
1_6	do	do						2.42	4.06 8.28	33.62	111,000	114,000	3,391
4_1	The Southern Clay Manufacturing Co., Coaldale, Ala.	Red, Coaldale paving block	8 2.00	8 8.75	4.75	3.7	8.1	3.75	3.11 8.68	26.99	134,000	372,000	13,783
4_2	do	do	7 14.25	8 8.25	10.00	7.9	16.4	3.97	3.06 8.71	26.65	142,000	236,500	8,874
4_3	do	do						3.91	3.05 8.50	25.93	60,000	297,000	11,454
4_4	do	do						3.77	3.06 8.64	26.44	99,000	296,500	11,214
4_5	do	do						3.91	3.04 8.50	25.84	161,000	340,000	13,158
4_6	do	do						3.95	3.01 8.51	25.62	99,000	244,800	9,555
4_7	Graves Shale Brick Co., Birmingham, Ala.	Red, paving block	8 9.75	8 12.75	3.00	2.2	5.0	3.94	3.05 8.60	26.23	118,000	315,000	12,009
4_8	do	do	8 10.50	8 11.50	1.00	0.7	1.6	4.05	3.04 8.61	26.17	69,000	286,000	10,929
4_9	do	do						4.06	3.03 8.58	26.00	53,000	292,000	11,231
4_{10}	do	do						4.09	3.14 8.83	27.74	217,000	470,000	16,949
4_{11}	do	do						3.98	3.05 8.72	26.60	270,000	397,000	14,925
4_{12}	do	do						4.06	3.02 8.55	25.82	110,000	349,800	13,548
4_{13}	do	do						4.02	3.03 8.60	26.06	178,000	356,500	13,680
4_{14}	do	do						3.95	3.03 8.69	26.33	42,000	349,000	13,255
5_1	Denny Clay Co., Seattle, Wash.	Buff-colored, building brick	4 4.75	4 15.00	10.25	14.9	26.2	2.43	3.16 8.10	[a] 27.76	157,500	157,500	5,673
5_2	do	do	5 11.75	6 8.25	12.50	13.6	25.5	2.44	4.25 8.40	[a] 34.76	185,000	211,000	6,070
5_3	do	do						2.46	4.30 8.50	[a] 31.76	89,000	101,000	3,180
5_4	do	do						2.46	4.30 8.45	[a] 31.66	87,000	105,100	3,319

[a] Net. Irregular shapes.

BRICKS—Continued.

TESTS OF MATERIAL COLLECTED AT THE LOUISIANA PURCHASE EXPOSITION, ST. LOUIS, MO., 1904—Continued.

Marks	From—	Description.	Weight.		Absorption.			Dimensions.			Sectional area.	First crack.	Compressive strength.	
			Dry.	Wet.	Total.	By weight.	By volume.	Height.	Compressed surface.				Total.	Per square inch.
			Lbs. oz.	*Lbs. oz.*	*Oz.*	*Per ct.*	*Per ct.*	*In.*	*In.*	*In.*	*Sq. in.*	*Pounds.*	*Pounds.*	*Lbs.*
5_6	Washington Brick, Lime and Manufacturing Co., Spokane, Wash.	Brown, sidewalk brick	9 13.00	10 1.50	4.50	2.9	6.3	2.45	4.97	10.10	50.20	132,000	510,000	10,159
5_6	.....do	.....do						2.44	4.98	10.12	50.40	195,000	534,000	10,595
5_7	.....do	Light-buff, building brick	6 10.75	7 10.75	16.00	15.0	26.9	2.60	4.46	8.89	39.65	84,000	112,000	2,825
5_8	.....do	.....do						2.61	4.41	8.83	38.94	89,000	116,800	2,999
5_9	.....do	.....do						2.60	4.41	8.83	38.94	119,000	149,600	3,842
5_{10}	.....do	.....do						2.61	4.42	8.82	38.98	92,000	120,100	3,081
5_{11}	.....do	.....do						2.61	4.52	8.92	40.32	72,000	99,500	2,468
5_{12}	.....do	.....do						2.60	4.50	8.83	39.74	81,000	107,600	2,708
5_{13}	State of Washington	Cream-colored, building brick	5 1.00	5 15.50	14.50	17.9	29.7	2.48	4.07	8.37	34.07	106,000	118,500	3,478
5_{14}	.....do	.....do						2.48	4.07	8.38	34.11	131,000	131,000	3,841
5_{15}	.....do	.....do						2.49	4.11	8.37	34.40	164,000	169,500	4,927
5_{16}	.....do	.....do						2.48	4.11	8.34	34.28	156,100	156,100	4,554
5_{17}	.....do	.....do						2.49	4.09	8.39	34.32	157,500	157,500	4,589
5_{18}	.....do	.....do						2.48	4.08	8.35	34.07	102,500	102,500	3,009
5_{19}	Renton Clay Works, Renton, Wash.	Red, building brick	5 15.25	6 11.75	12.50	13.1	24.6	2.45	4.19	8.55	35.82	212,000	228,000	6,365
5_{20}	.....do	.....do						2.41	4.16	8.55	35.57	258,000	284,500	7,998
5_{21}	.....do	.....do						2.42	4.13	8.52	35.19	259,000	261,000	7,417
5_{22}	.....do	.....do						2.45	4.18	8.60	35.95	201,000	201,000	5,591
6_1	State of Maryland. "Queen City."	Dark-red, paving brick	7 5.25	7 13.25	8.00	6.8	14.3	4.22	2.66	8.63	22.96	170,000	193,000	8,408
6_2	.....do	Light-red, paving brick						4.00	3.42	8.75	29.93	243,000	271,000	9,054
7_1	Conococheague, Maryland	Red, building brick	4 10.25	5 4.00	9.75	13.1	23.6	2.20	3.95	8.22	32.47	118,000	154,000	4,743
7_2	.....do	.....do						2.18	3.93	8.28	32.54	133,000	166,000	5,101
8_1	Mount Savage, Md	Buff-colored, fire brick	5 7.25	6 0.25	9.00	10.3	19.2	2.10	4.38	8.83	38.68	32,500	115,000	2,973
8_2	.....do	.....do						2.53	4.38	8.94	39.16	34,000	92,500	2,362

9₁	Maryland clay	Light-red, hollow, partition bricks stamped 21.	3	6.50	3	14.50	8.00	14.7	21.9	2.30	3.58	8.08	[a] 28.93	61,000	63,200	2,185
9₂	do	do	3	5.75	3	13.75	8.00	14.9	22.2	2.30	3.57	8.01	[a] 28.60	32,600	37,500	1,311
9₃	do	Medium light-red, hollow partition bricks, stamped 22.								2.27	3.48	7.96	[a] 27.70	39,100	39,100	1,410
9₄	do	Medium red, hollow partition bricks, stamped 24.								2.25	3.54	7.80	[a] 27.61	29,700	29,700	1,076
9₅	do	do								2.26	3.52	7.74	[a] 27.24	18,200	27,100	995
9₆	do	Medium red, hollow partition bricks, stamped 25.								2.20	3.48	7.78	[a] 27.07	47,000	53,500	1,976
10₁	Cumberland Granite Brick Co., Maryland.	Cream-colored, sand-lime face brick.	4	11.25	5	8.25	13.00	17.3	28.4	2.36	4.02	8.34	33.53	114,000	125,000	3,728
10₂	do	Parti-colored cream and pink, sand-lime face brick.								2.43	4.03	8.37	33.73	101,000	128,000	3,795
10₃	do	Brown, sand-lime face brick								2.43	4.04	8.37	33.81	102,000	119,500	3,534
10₄	do	Red, sand-lime face brick								2.38	4.02	8.35	33.57	99,000	101,000	3,009
11₁	Frederick Brick Works, Maryland.	Red, face brick	5	13.00	6	5.00	8.00	8.6	17.7	2.29	4.02	8.46	34.01	278,000	386,000	11,350
11₂	do	do								2.31	4.08	8.49	34.69	307,000	345,000	9,945
11₃	do	Light-red, face brick	5	15.50	6	15.50	16.00	16.8	30.2	2.46	4.25	8.77	37.27	181,000	208,000	5,581
11₄	do	Dark-red, face brick								2.30	3.89	8.12	31.59	229,000	459,000	14,530
11₅	do	do								2.28	3.92	8.13	31.87	375,000	594,000	18,638
11₆	do	do								2.27	3.87	8.12	31.42	170,000	545,000	17,346
12₁	Maryland clay	Dark-cream brick, stamped 21.	4	1.25	4	11.25	10.00	15.3	26.9	2.21	3.70	7.86	29.08	101,000	129,500	4,453
12₂	do	Dark-cream brick, stamped 23.								2.17	3.52	7.60	26.75	138,000	201,000	7,514
12₃	do	do								2.17	3.53	7.60	26.83	171,000	196,000	7,305
12₄	do	Light-red brick, stamped 24	3	13.25	4	7.75	10.50	17.1	29.8	2.24	3.58	7.59	27.17	50,000	61,500	2,264
12₅	do	do								2.17	3.57	7.60	27.13	42,000	78,000	2,875
12₆	do	Light-red brick, stamped 26								2.13	3.50	7.48	26.18	48,000	122,000	4,660
13₁	P. Bannon & Co., Louisville, Ky.	Gray-colored brick	5	15.25	6	1.75	2.50	2.6	5.8	2.28	3.96	8.30	32.87	193,000	552,000	16,793
13₂	do	Dark-gray brick								2.30	4.00	8.30	33.20	320,000	665,000	20,030
13₃	do	Dark-cream brick	6	3.25	7	0.	12.75	12.8	24.9	2.43	4.20	8.67	36.41	198,000	261,000	7,168
13₄	do	do								2.35	4.18	8.63	36.07	185,000	299,800	8,312
13₅	do	do								2.40	4.23	8.73	36.93	87,000	194,500	5,267
13₆	do	do								2.42	4.24	8.72	36.97	151,000	211,000	5,707
13₇	do	do								2.37	4.20	8.70	36.54	227,000	243,000	6,650
13₈	do	do								2.36	4.10	8.50	34.85	102,000	361,000	10,359
13₉	do	Rose-colored fire brick, branded "Ætna Crown."	6	8.50	7	3.75	11.75	10.8	19.9	2.50	4.36	8.97	39.11	32,000	91,000	2,327
13₁₀	do	do								2.40	4.45	9.00	40.05	23,000	129,500	3,233
13₁₁	do	do								2.50	4.46	9.04	40.32	19,500	103,000	2,555
13₁₂	do	Chocolate-colored paving block, branded "Bannon's Block."	8	8.25	8.	9.00	0.75	0.6	1.2	3.97	3.04	8.89	27.03	139,000	393,000	14,539

[a] Gross.

BRICKS—Continued.

TESTS OF MATERIAL COLLECTED AT THE LOUISIANA PURCHASE EXPOSITION, ST. LOUIS, MO., 1904—Continued.

Marks.	From—	Description.	Weight.		Absorption.			Dimensions.			Sectional area.	First crack.	Compressive strength.	
			Dry.	Wet.	Total.	By weight.	By volume.	Height.	Compressed surface.				Total.	Per square inch.
			Lbs. oz.	*Lbs. oz.*	*Oz.*	*Per ct.*	*Per ct.*	*In.*	*In.*	*In.*	*Sq. in.*	*Pounds.*	*Pounds.*	*Lbs.*
13_{13}	P. Bannon & Co., Louisville, Ky.	Chocolate-colored paving brick, branded "Bannon's Paver."	6 9.25	6 10.75	1.50	1.4	3.2	3.98	2.48	8.21	20.36	176,000	231,500	11,370
13_{14}	....do	....do						3.98	2.59	8.33	21.57	127,000	274,000	12,703
13_{15}	....do	....do						3.95	2.48	8.26	20.48	36,000	231,000	11,279
13_{16}	....do	....do						3.97	2.48	8.24	20.44	54,000	225,500	11,032
13_{17}	....do	....do						3.98	2.50	8.26	20.65	42,000	199,800	9,676
13_{18}	....do	....do						4.00	2.50	8.25	20.63	99,000	191,500	9,283
13_{19}	....do	....do						4.02	2.53	8.26	20.90	65,000	225,000	10,766
14_1	Louisville Press Brick Co., Louisville, Ky.	Red-colored face brick	5 5.50	6 4.75	15.25	17.8	31.4	2.43	4.10	8.44	34.60	174,000	179,500	5,190
14^i	....do	....do	5 5.75	6 4.50	14.75	17.2	30.5	2.40	4.12	8.46	34.86	49,000	146,000	4,188
14_3	....do	....do						2.39	4.11	8.46	34.77	15,000	161,000	4,630
14_4	....do	....do						2.39	4.10	8.47	34.73	175,000	187,000	5,384
14_5	....do	....do						2.39	4.09	8.48	34.68	10,000	166,000	4,787
14_6	....do	....do						2.38	4.10	8.49	34.81	218,000	233,000	6,693
14_7	....do	....do						2.44	4.10	8.48	34.77	13,000	202,000	5,810
14_8	....do	....do						2.46	4.09	8.47	34.64	97,000	192,000	5,543
16_1	Platt Pressed and Fire Brick Co., Van Meter, Iowa.	Orange-colored face brick	5 11.00	6 2.75	7.75	8.5	16.2	2.40	4.17	8.27	34.49	340,000	397,000	11,511
16_2	....do	Buff-colored face brick						2.35	4.02	8.04	32.32	260,000	282,000	8,725
16_3	....do	....do						2.38	3.97	8.06	32.00	269,000	290,500	9,078
17_1	The Corey Pressed Brick Co., Lehigh, Iowa.	Buff-colored face brick	5 11.25	6 2.25	7.00	7.7	15.9	2.29	4.02	8.29	33.33	290,000	424,000	12,721
17_2	....do	....do						2.28	4.10	8.33	34.15	310,000	381,500	11,171
17_3	....do	....do						2.27	4.27	8.39	34.70	216,000	257,500	7,420
18_1	James Maine & Son, Des Moines, Iowa.	Common hard-burned, sand-mold, dark-red brick.						2.47	3.78	a4.86	18.37	110,000	141,000	7,676
18_2	....do	....do	4 15.50	5 5.00	5.50	6.9	12.9	2.48	3.71	8.03	29.79	183,000	317,000	10,641
18_3	....do	....do						2.43	3.69	8.00	29.52	178,000	298,000	10,095
18_4	....do	....do						2.51	3.69	7.98	29.45	205,000	285,000	9,677

19_1	Davenport Paving Brick and Tile Co., Davenport, Iowa.	Common dark-red brick	5	11.00	5	15.25	4.25	4.7	9.6	2.21	4.13	8.36	34.53	128,000	328,500	9,513
19_2	do	Dark-red paver	7	6.25	7	10.25	4.00	3.4	7.3	3.86	2.96	8.26	24.45	47,000	122,000	4,990
19_3	do	do								3.89	2.93	8.25	24.17	88,000	123,500	5,110
20_1	Boone Brick, Tile, and Paving Co., Boone, Iowa.	Dark-chocolate, face brick	6	14.25	7	1.50	3.25	2.9	6.5	4.03	2.59	8.30	21.50	134,000	176,000	8,186
20_2	do	do								4.08	2.52	8.29	20.89	67,000	104,000	4,978
21_1	Iowa Falls Press Brick Co., Iowa Falls, Iowa.	Rose-colored, face brick	5	0.75	5	15.00	14.25	17.6	30.0	2.43	4.05	8.34	33.78	339,000	360,000	10,657
21_2	do	Dark-rose, sidewalk brick								2.33	4.15	8.36	34.69	200,000	209,800	6,048
22_1	Iowa Granite Brick Co., Clinton, Iowa.	Light-gray, sand-lime brick	5	10.50	6	5.75	11.25	12.4	23.0	2.42	4.14	8.45	34.98	198,200	198,200	5,666
22_2	do	do								2.41	4.13	8.45	34.90	164,000	164,000	4,699
22_3	do	do								2.42	4.14	8.45	34.98	160,000	162,000	4,631
22_4	do	do								2.40	4.14	8.46	35.02	143,500	143,500	4,098
23_1	The Gethman Brick Co., Gladbrook, Iowa.	Medium-red, face brick	5	1.75	5	14.00	12.25	15.0	27.1	2.37	4.01	8.22	32.96	230,000	266,000	8,070
23_2	do	Medium-red, pressed brick								2.35	4.00	8.24	32.96	267,000	308,000	9,345
23_3	do	do								2.36	3.93	8.20	32.23	193,000	249,000	7,726
23_4	do	do								2.36	3.97	8.17	32.38	190,000	264,000	8,153
24_1	Casper Brick Co., Casper, Wyo.	Light red, dry-pressed brick	4	11.75	5	3.25	7.50	9.9	17.9	2.20	3.96	8.34	33.03	209,000	321,800	9,743
24_2	do	do								2.31	4.12	8.41	34.65	149,000	240,000	6,926
24_3	do	Red, dry-pressed brick								2.28	4.24	8.68	36.80	81,000	98,000	2,663
25_1	Scott & Gould Weston County, Wyo.	Rose-colored brick	3	12.00	4	7.75	11.75	19.6	31.0	2.18	3.93	7.67	30.14	34,000	69,900	2,319
25_2	do	do								2.18	3.90	7.64	29.80	61,000	66,200	2,221
25_3	do	do								2.18	3.92	7.67	30.07	70,100	70,100	2,331
26_1	Brenning & Rhoades, Douglas, Wyo.	Light red, light hard brick								2.38	4.23	8.50	35.96	139,000	154,000	4,283
26_2	do	do	5	1.00	6	0.50	15.50	19.1	32.1	2.34	4.21	8.47	35.66	12,000	103,000	2,888
26_3	do	do								2.35	4.20	8.46	35.53	93,000	113,000	3,180
27_1	The Muskogee Vitrified Brick Co., Muskogee, Ind. T.	Red, face brick	6	7.75	6	14.75	7.00	6.7	14.9	2.43	4.08	8.22	33.54	312,000	332,000	9,899
27_2	do	do								2.39	4.07	8.24	33.54	331,000	373,000	11,117
27_3	do	do								2.41	4.07	8.31	33.82	110,000	326,000	9,639
27_4	do	do								2.38	4.05	8.22	33.29	225,000	407,000	12,226
27_5	do	do								2.43	4.16	8.35	34.74	215,000	312,000	8,981
27_6	do	do								2.38	4.10	8.23	33.74	140,000	307,000	9,099
27_7	do	do								2.42	4.07	8.19	33.33	208,000	303,500	9,106
27_8	do	do								2.36	4.06	8.25	33.50	234,000	319,500	9,537

[a] Half-brick.

BRICKS—Continued.

TESTS OF MATERIAL COLLECTED AT THE LOUISIANA PURCHASE EXPOSITION, ST. LOUIS, MO., 1904—Continued.

Marks.	From—	Description.	Weight.		Absorption.			Dimensions.			Sectional area.	First crack.	Compressive strength.	
			Dry.	Wet.	Total.	By weight.	By volume.	Height.	Compressed surface.				Total.	Per square inch.
			Lbs. oz.	*Lbs. oz.*	*Oz.*	*Per ct.*	*Per ct.*	*In.*	*In.*	*In.*	*Sq. in.*	*Pounds.*	*Pounds.*	*Lbs.*
28$_1$	Choctaw Pressed Brick Co., South McAlester, Ind. T.	Light-red, face brick						2.46	3.99	8.16	32.56	205,000	205,000	6,296
28$_2$	do	do	5 14.00	6 6.25	8.25	8.8	17.8	2.47	3.99	8.15	32.52	230,000	230,800	7,097
28$_3$	do	do						2.47	3.99	8.14	32.48	212,000	229,500	7,066
28$_4$	do	do						2.45	3.99	8.16	32.56	214,000	221,000	6,787
28$_5$	do	do						2.46	3.97	8.18	32.47	239,000	244,000	7,515
28$_6$	do	do						2.48	3.99	8.10	32.32	196,000	199,000	6,157
29$_1$	The Muskogee Vitrified Brick Co., Muskogee, Ind. T.	Dark-red, paving brick	6 5.75	6 10.50	4.75	4.7	10.2	4.09	2.40	8.15	19.56	82,000	83,000	4,243
29$_2$	do	do						4.01	2.51	8.27	20.76	128,000	135,000	6,503
29$_3$	do	do						4.03	2.50	8.27	20.68	89,000	141,000	6,818
29$_4$	do	do						3.98	2.44	8.16	19.91	89,000	132,000	6,630
29$_5$	do	do						3.96	2.43	8.15	19.80	41,000	145,000	7,323
29$_6$	do	do						4.00	2.46	8.11	19.95	66,000	119,500	5,990
30$_1$	do	Red, sidewalk brick	6 5.25	6 11.75	6.50	6.4	13.8	2.43	4.05	8.27	33.49	381,000	381,000	11,377
30$_2$	do	do						2.39	3.94	8.25	32.51	184,000	267,000	8,213
30$_3$	do	do						2.33	4.01	8.17	32.76	185,000	484,000	14,774
30$_4$	do	do						2.38	4.01	8.21	32.92	193,000	411,000	12,485
30$_5$	do	do						2.33	4.02	8.15	32.76	290,000	456,000	13,919
30$_6$	do	do						2.36	4.02	8.16	32.80	240,000	432,000	13,171
31$_1$	Bartlesville Vitrified Brick Co., Bartlesville, Ind. T.	Red-colored brick	5 9.75	6 0.50	6.75	7.5	15.9	2.40	3.70	8.28	30.64	159,000	359,900	11,746
31$_2$	do	do						2.40	3.68	8.30	30.54	73,000	346,000	11,329
32$_1$	Poteau Pressed Brick and Tile Co., Poteau, Ind. T.	Light hard, red brick	4 15.50	5 14.25	14.75	18.6	32.3	2.32	4.10	8.29	33.99	100,100	100,100	2,945
32$_2$	do	do						2.34	4.11	8.30	34.11	99,300	99,300	2,911
33	Tulso, Ind. T	Red brick	5 9.00	6 2.25	9.25	10.4	21.0	2.40	3.90	8.13	31.71	230,000	268,000	8,452

41$_1$	Humboldt Brick Co., Humboldt, Kans.	Dark-red, sidewalk brick	4	15.75	5	13.00	13.25	16.6	29.0	2.20	4.21	8.51	35.83	331,000	383,000	10,689
41$_2$	do	do								2.20	4.21	8.53	35.91	308,000	369,000	10,276
41$_3$	do	do								2.21	4.23	8.52	36.04	320,000	423,000	11,737
41$_4$	do	do								2.20	4.19	8.50	35.62	260,000	387,000	10,865
41$_5$	do	do								2.19	4.21	8.52	35.87	220,000	437,000	12,183
41$_6$	do	do								2.20	4.18	8.45	35.32	210,000	429,000	12,146
42	do	Dark-red, vitrified brick	5	0.50	5	11.50	11.00	13.7	25.1	2.20	4.11	8.40	34.52	374,000	468,000	13,557
43$_1$	The Fredonia Brick Co., Fredonia, Kans.	Red, gas-burnt bricks	5	5.75	5	13.00	7.25	8.5	17.7	2.33	3.79	8.03	30.43	124,000	320,500	10,532
43$_2$	do	do								2.32	3.70	8.10	29.97	182,000	299,000	9,977
43$_3$	do	do								2.34	3.74	8.14	30.44	62,000	234,000	7,687
43$_4$	do	do								2.35	3.80	8.17	31.05	45,000	296,000	9,533
44$_1$	The Capital City Vitrified Brick and Paving Co., Topeka, Kans.	Dark-red pavers; tested on edge.	5	8.75	5	10.50	1.75	1.9	4.5	3.85	2.23	7.91	17.64	108,000	219,500	12,443
44$_2$	do	do								3.93	2.23	7.90	17.62	65,000	144,000	8,173
44$_3$	do	do								3.94	2.23	7.95	17.73	46,000	115,000	6,486
44$_4$	The Fort Scott Brick Co., Fort Scott, Kans.	Red pavers, tested on edge	6	7.25	6	13.25	6.00	5.9	12.5	3.90	2.68	7.96	21.33	228,000	299,000	14,018
44$_5$	do	do								3.86	2.67	7.96	21.25	336,000	352,000	16,565
44$_6$	The Ottawa Brick and Tile Co., Ottawa, Kans.	do	5	14.75	6	1.50	2.75	2.9	6.6	3.68	2.45	7.94	19.45	28,000	111,500	5,733
44$_7$	do	do								3.70	2.41	7.94	19.14	93,000	168,000	8,777
44$_8$	Atchison Paving Brick Co., Atchison, Kans.	do	5	11.75	5	12.75	1.00	1.1	2.4	3.95	2.34	7.78	18.21	32,000	102,000	5,601
44$_9$	do	do								3.94	2.34	7.81	18.28	46,000	124,000	6,783
44$_{10}$	The Coffeyville Vitrified Brick and Tile Co., Cherryvale, Kans.	Dark-red pavers; tested on edge.	6	8.50	6	11.75	3.25	3.1	7.1	4.00	2.40	8.30	19.92	154,000	298,000	14,960
44$_{11}$	do	do								4.11	2.45	8.45	20.70	81,000	162,500	7,850
44$_{12}$	do	do								4.24	2.45	8.54	20.92	159,000	164,000	7,839
44$_{13}$	Pittsburg Vitrified Paving and Building Brick Co., Pittsburg, Kans.	Dark-red pavers; tested on edge; gas burnt.	6	0.75	6	1.75	1.00	1.0	2.4	3.90	2.36	7.98	18.83	67,000	160,500	8,524
44$_{14}$	do	Light-red pavers; tested on edge; gas burnt.								4.13	2.45	8.48	20.78	99,000	117,000	5,630
44$_{15}$	The Lawrence Vitrified Brick and Paving Co., Lawrence, Kans.	Dark-red, face brick	6	1.75	6	7.75	6.0	6.1	12.9	2.42	3.96	8.39	33.22	116,000	371,000	11,168
44$_{16}$	do	do								2.40	3.94	8.40	33.10	119,000	376,000	11,360

BRICKS—Continued.

TESTS OF MATERIAL COLLECTED AT THE LOUISIANA PURCHASE EXPOSITION, ST. LOUIS, MO., 1904—Continued.

Marks.	From—	Description.	Weight.		Absorption.			Dimensions.			Sectional area.	First crack.	Compressive strength.	
			Dry.	Wet.	Total.	By weight.	By volume.	Height.	Compressed surface.				Total.	Per square inch.
			Lbs. oz.	*Lbs. oz.*	*Oz.*	*Per ct.*	*Per ct.*	*In.*	*In.*	*In.*	*Sq. in.*	*Pounds.*	*Pounds.*	*Lbs.*
44_{17}	Columbus Vitrified Brick and Tile Co., Columbus, Kans.	Light-red, face brick	6 7.75	7 3.50	11.75	11.3	22.3	2.30	4.46	8.90	39.69	153,000	349,000	8,793
44_{18}	....do	....do						2.33	4.43	8.91	39.47	198,000	393,000	9,957
44_{19}	....do	....do						2.31	4.46	8.96	39.96	148,000	320,000	8,008
44_{20}	....do	Light-red face brick; broken into halves.						2.35	4.46	8.99	40.10	126,000	165,000	4,115
46_1	Ogden City Pressed Brick and Clay Co., Ogden, Utah.	Light-orange, face brick	4 0.25	4 15.75	15.50	24.1	39.4	1.88	4.25	8.51	36.17	153,500	153,500	4,243
46_2	....do	Orange, face brick						2.50	4.41	8.92	39.34	184,000	184,000	4,677
46_3	....do	Cream, face brick						2.67	4.51	9.12	41.13	129,000	129,000	3,136
46_4	....do	Light-red, face brick	5 2.25	6 4.00	17.75	21.6	34.6	2.55	4.17	8.36	34.84	11,000	83,000	2,382
46_5	....do	....do	5 4.50	6 5.75	17.25	20.4	33.5	2.55	4.18	8.36	34.94	106,500	106,500	3,048
46_6	....do	....do						2.53	4.18	8.36	34.94	14,000	99,000	2,833
46_7	....do	....do						2.55	4.18	8.36	34.94	9,000	96,000	2,748
46_8	....do	....do						2.53	4.14	7.85	32.50	5,000	80,500	2,477
47_1	Jamestown Shale and Paving Brick Co., Jamestown, N. Y.	Dark-red paving bricks; tested on edge.	7 10.50	7 14.75	4.25	3.5	7.6	3.95	2.99	8.20	24.52	156,000	294,000	11,990
47_2	....do	....do	7 10.50	7 15.00	4.50	3.7	8.0	3.95	3.00	8.24	24.72	193,000	299,500	12,116
47_3	....do	....do						4.02	3.00	8.25	24.75	199,000	319,600	12,913
47_4	....do	....do						3.99	3.00	8.24	24.72	130,000	246,000	9,951
47_5	....do	....do						4.00	3.00	8.26	24.78	218,000	282,000	11,380
47_6	....do	....do						4.11	3.01	8.47	25.49	198,000	269,000	10,553
48_1	Budapest, Hungary	Dark-brown, magnesite brick	8 15.50	9 11.50	12.00	8.4	21.9	2.56	4.26	8.69	37.02	465,000	465,000	12,561
48_2	....do	....do	8 8.25	9 5.50	13.25	9.7	24.8	2.51	4.20	8.76	36.79	351,000	351,000	9,541
48_3	....do	....do						2.60	4.27	8.73	37.28	267,000	267,000	7,162
48_4	....do	....do						2.66	4.28	8.97	38.39	185,000	185,000	4,819
48_5	....do	....do						2.65	4.21	8.93	37.60	110,000	110,000	2,926
48_6	....do	....do						2.65	4.22	8.92	37.64	145,000	145,000	3,852

49[1]	Mitchell Clay Manufacturing Co., St. Louis, Mo.	Buff-colored face brick	5	13.00	6	4.50	7.50	8.1	16.2	2.40	4.02	8.32	33.45	35,000	414,000	12,377
49[2]	.....do	.....do	5	14.00	6	7.50	9.50	10.1	19.8	2.44	4.05	8.38	33 94	126.000	246,000	7,248
49[3]	.....do	.....do								2.41	4.00	8.42	33.68	234,000	317,000	9,412
49[4]	.....do	.....do								2.44	4.00	8.47	33.88	150,000	383,000	11,305
49[5]	.....do	.....do								2.46	4.10	8.54	35.01	228,000	298,000	8,512
49[6]	.....do	.....do								2.46	4.10	8.52	34.93	171,000	235,000	6,728
50[1]	The Parker-Russell Mining and Manufacturing Co., St. Louis, Mo.	Buff-colored fire brick	7	7.00	8	1.75	10.75	9.0	17.8	2.55	4.54	9.01	40.91	135,000	279,800	6,839
50[2]	.....do	.....do								2.56	4.51	9.03	40.73	210,000	274,000	6,727
50[3]	.....do	.....do								2.52	4.52	9.00	40.68	182,000	257,000	6,318
50[4]	.....do	.....do								2.54	4.51	9.04	40.77	205,000	267,000	6,549
50[5]	.....do	.....do								2.55	4.51	9.03	40.73	178,000	213,000	5,230
50[6]	.....do	.....do								2.55	4.50	9.06	40.77	176,000	272,000	6,672
51[1]	St. Louis Vitrified and Fire Brick Co., St. Louis, Mo.	Dark-red bricks; serrated surface.	6	12.25	6	14.00	1.75	1.6	3.7	2.36	4.11	8.53	35.06	335,000	792,000	22,590
51[2]	.....do	.....do								2.43	4.05	8.50	34.43	430,000	[a]800,000	23,236
51[3]	.....do	.....do								2.38	4.11	8.52	35.02	410,000	[a]800,000	22,844
51[4]	.....do	.....do								2.47	4.13	8.46	34.94	320,000	[a]800,000	22,896
50[b]	.....do	Dark-red brick	7	3.25	7	3.50	0.25	0.2	0.5	2.46	3.98	8.62	34.31	135,000	[a]800,000	23,317
51[11]	.....do	Branded "St. Louis V. & F. B. Co."	8	10.75	8	12.00	1.25	0.9	2.1	3.99	2.90	8.93	25.90	230,000	341,000	13,170
51[12]	.....do	.....do	8	12.25	8	12.75	0.50	0.4	0.9	3.99	2.90	8.97	26.01	115,000	274,000	10,530
51[13]	.....do	.....do								4.00	2.89	8.99	25.98	110,000	239,500	9,220
51[14]	.....do	.....do								3.98	2.90	8.94	25.93	218,000	320,000	12,340
52[1]	Missouri	Dark-brown, "Athens Block"	10	1.25	10	4.25	3.00	1.9	4.1	4.09	3.43	9.07	31.11	230,000	329,000	10,580
52[2]	.....do	.....do	9	15.00	10	1.75	2.75	1.7	3.7	4.07	3.51	9.00	31.50	225,000	355,000	11,240
52[3]	.....do	.....do								4.06	3.45	9.05	31.22	210,000	371,000	11,880
52[4]	.....do	.....do								4.05	3.47	9.06	31.44	180.000	272,500	8,670
53[1]	.....do	Brown, "Malvern Blue Granite" paver.	11	13.50	12	2.50	5.00	2.6	5.6	4.87	3.55	8.86	31.45	318,000	372,000	11,830
53[2]	.....do	.....do								4.93	3.50	8.82	30.87	305.000	319,000	10,330
53[3]	.....do	.....do								4.88	3.50	8.80	30.80	298,000	350,500	11,380
54	.....do	Brown, "M.C.Co." paver block								4.17	3.40	8.59	29.21	165,000	249,800	8,550
55[1]	.....do	Brown, paver block	9	9.25	9	13.00	3.75	2.4	5.2	4.16	3.46	8.60	29.76	130,000	263,000	8,840
55[2]	.....do	.....do								4.08	3.47	8.61	29.88	235,000	388,000	12,980
56[1]	.....do	Buff colored bricks, marked "Missouri No. 1, S.Louis."	6	12.00	7	6.25	10.25	9.5	19.3	2.48	4.29	8.63	37.02	198,000	287,000	7,750
56[2]	.....do	.....do	6	12.50	7	6.00	9.50	8.8	17.8	2.50	4.28	8.61	36.85	215,000	296,000	8,030
56[3]	.....do	.....do								2.50	4.31	8.61	37.11	188,000	256,000	6,900

[a] Not completely ruptured.

BRICKS—Continued.

TESTS OF MATERIAL COLLECTED AT THE LOUISIANA PURCHASE EXPOSITION, ST. LOUIS, MO., 1904—Continued.

Marks.	From—	Description.	Weight.		Absorption.			Dimensions.			Sectional area.	First crack.	Compressive strength.	
			Dry.	Wet.	Total.	By weight.	By volume.	Height.	Compressed surface.				Total.	Per square inch.
			Lbs. oz.	*Lbs. oz.*	*Oz.*	*Per ct.*	*Per ct.*	*In.*	*In.*	*In.*	*Sq. in.*	*Pounds.*	*Pounds.*	*Lbs.*
56_4	Missouri	Buff-colored bricks, marked "Missouri No. 1, St. Louis."						2.50	4.27	8.71	37.19	82,000	274,500	7,380
56_5	....do	....do						2.47	4.29	8.62	36.98	40.000	270,000	7,300
56_6	....do	....do						2.48	4.25	8.70	36.98	.....	269,100	7,280
56_7	....do	....do						2.49	4.29	8.60	26.89	170,000	228,000	6,180
56_8	....do	....do						2.50	4.30	8.60	36.98	212,000	276,200	7,470
56_9	....do	....do						2.48	4.30	8.59	36.94	187,000	262,000	7,090
56_{10}	....do	....do						2.50	4.28	8.75	37.45	198,000	263,000	7,020
56_{11}	....do	....do						2.48	4.31	8.67	37.37	18,000	205,000	5,490
56_{12}	....do	....do						2.47	4.30	8.64	37.15	186,000	216,000	5,810
57_1	....do	Buff-colored, fire brick	5 5.25	6 2.75	13.50	15.8	23.2	2.50	4.42	9.10	40.22	128,000	231,000	5,740
57_2	....do	....do						2.12	4.46	9.10	40.59	56,000	231,000	5,690
58_1	New Mexico	Dark-brown, nearly vitrified, common brick.	4 15.50	5 3.50	4.00	5.0	10.5	2.25	3.70	7.89	29.19	95,000	283,000	9,700
58_2	....do	....do						2.26	3.69	7.84	28.93	76,000	299,000	10,340
58_3	....do	....do						2.26	3.68	7.79	28.67	175,000	368,000	12,840
58_4	....do	Dark-brown, vitrified sidewalk brick.	5 13.25	6 1.25	4.00	4.3	8.9	1.80	4.60	9.35	43.01	224,000	559,000	13,000
58_5	....do	....do						1.84	4.60	9.31	42.83	250,000	582,000	13,590
58_6	....do	....do						1.79	4.60	9.28	42.69	320,000	584,000	13,680
58_7	....do	....do						1.83	4.61	9.38	43.24	370,000	558,000	12,900
58_{10}	....do	Rose-colored, face or common building brick.	5 0.50	5 13.00	12.50	15.5	28.8	2.35	3.91	8.16	31.91	45,000	172,500	5,410
58_{11}	....do	....do						2.32	3.92	8.18	32.07	120,000	170,200	5,310
58_{12}	....do	....do						2.35	3.90	8.15	31.79	62,000	160,500	5,050
58_{13}	....do	....do						2.35	3.90	8.14	31.75	88,000	191,000	6,020
58_{14}	....do	....do						2.36	3.91	8.18	31.98	89,000	155,000	4,850
58_{20}	....do	....do						2.35	3.91	8.18	31.98	112,000	124,000	3,880

58 17	....do	Common, light-red brick	5 4.25	6 1.50	13.25	15.7	28.2	2.39	4.06	8.37	33.98	82,000	141,000	4,150
58 18	....do	....do						2.39	4.06	8.37	33.98	98,000	131,000	3,860
58 19	....do	....do						2.40	4.05	8.36	33.86	119,000	131,500	3,880
58 20	....do	....do						2.38	4.06	8.37	33.98	105,000	129,400	3,810
58 21	....do	....do						2.39	4.05	8.37	33.90	119,000	134,500	3,970
59 1	Laclede Fire Brick Manufacturing Co., St. Louis, Mo.	"Laclede, St. Louis," buff-colored fire-brick.	6 9.00	7 6.25	13.25	12.6	23.6	2.51	4.34	8.90	38.63	130,000	165,000	4,270
59 2	....do	....do						2.53	4.35	8.94	38.89	148,000	186,000	4,780
59 3	Mississippi Glass Co., St. Louis, Mo.	"Walsh X" buff-colored fire brick.	6 15.00	7 10.25	11.25	10.1	19.7	2.50	4.44	8.92	39.60	54,000	112,000	2,830
59 4	....do	....do						2.46	4.38	8.84	38.72	83,000	151,000	3,900
59 5	....do	....do						2.50	4.46	8.87	39.56	52,000	120,000	3,030
59 6	Laclede Fire Brick Manufacturing Co., St. Louis, Mo.	"Laclede, St. Louis, XXX" buff-colored fire brick.	6 14.25	7 9.75	11.50	10.4	20.8	2.47	4.39	8.84	38.81	130,000	229,000	5,900
59 7	....do	....do						2.47	4.33	8.87	38.41	194,000	277,000	7,210
59 8	....do	....do						2.55	4.43	8.98	39.78	160,000	227,000	5,710
59 9	....do	....do						2.50	4.35	8.83	38.41	195,000	252,000	6,560
59 10	....do	....do						2.48	4.34	8.90	38.63	125,000	232,000	6,010
59 11	Mississippi Glass Co., St. Louis, Mo.	"Walsh ⚓" buff-colored fire brick.	6 15.50	7 12.00	12.50	11.2	21.4	2.54	4.43	9.00	39.87	29,000	94,500	2,370
59 12	....do	....do						2.55	4.34	8.87	38.50	33,000	116,000	3,010
59 13	....do	....do						2.50	4.36	8.96	39.07	27,000	101,000	2,590
59 14	....do	....do						2.61	4.39	8.98	39.42	26,000	84,500	2,140
59 15	....do	....do						2.52	4.42	9.00	39.78	33,000	124,000	3,120
59 16	....do	"Walsh XX" buff-colored fire brick.	7 0.50	7 11.50	11.00	9.8	19.0	2.54	4.41	8.95	39.47	31,000	111,000	2,810
59 17	....do	....do						2.53	4.38	8.91	39.03	37,000	100,600	2,580
59 18	....do	....do						2.50	4.45	8.91	39.65	42,000	102,000	2,570
59 19	....do	....do						2.51	4.43	8.90	39.43	38,000	104,000	2,640
59 20	....do	....do						2.50	4.44	8.87	39.38	45,000	99,500	2,530
59 21	....do	....do						2.48	4.35	8.89	38.67	61,000	112,500	2,910
59 22	....do	....do						2.54	4.41	8.95	39.47	34,000	101,000	2,560
59 23	....do	....do						2.51	4.42	8.91	39.38	42,000	106,000	2,690
59 24	....do	"Walsh Vanda." buff-colored fire brick.	6 15.50	7 8.50	9.00	8.1	16.7	2.48	4.28	8.80	37.66	176,000	382,000	10,140
59 25	....do	....do						2.42	4.28	8.73	37.36	199,000	318,000	8,510
59 26	....do	....do						2.46	4.33	8.78	38.02	210,000	295,500	7,770
59 27	....do	....do						2.47	4.34	8.80	38.19	234,000	353,000	9,240
59 28	....do	....do						2.46	4.28	8.77	37.54	244,000	306,000	8,150
59 29	....do	....do						2.45	4.34	8.80	38.19	210,000	307,500	8,050
59 30	....do	....do						2.46	4.36	8.81	38.41	212,000	313,000	8,150
59 31	....do	....do						2.45	4.32	8.81	38.06	242,000	331,000	8,700
59 32	Laclede Fire Brick Manufacturing Co., St. Louis, Mo.	Red, paver	9 7.00	9 9.75	2.75	1.8	4.4	3.80	3.20	8.98	28.74	216,000	293,000	10,190
59 33	....do	....do						3.82	3.31	9.10	30.12	114,000	232,060	7,720

BRICKS—Continued.

TESTS OF MATERIAL COLLECTED AT THE LOUISIANA PURCHASE EXPOSITION, ST. LOUIS, MO., 1904—Continued.

Marks.	From—	Description.	Weight.		Absorption.			Dimensions.			Sectional area.	First crack.	Compressive strength.	
			Dry.	Wet.	Total.	By weight.	By volume.	Height.	Compressed surface.				Total.	Per square inch.
			Lbs. oz.	*Lbs. oz.*	*Oz.*	*Per ct.*	*Per ct.*	*In.*	*In.*	*In.*	*Sq. in.*	*Pounds.*	*Pounds.*	*Lbs.*
59 24	Laclede Fire Brick Manufacturing Co., St. Louis, Mo.	Red, Laclede paver	7 10.00	7 11.25	1.25	1.0	2.3	3.98	2.80	8.47	23.72	65,000	115,000	4,850
59 25	do	do	7 10.25	7 11.75	1.50	1.2	2.6	3.99	2.87	8.60	24.68	87,000	157,600	6,390
59 26	do	do						3.91	2.90	8.54	24.77	98,000	205,200	8,280
59 27	do	do						3.95	2.84	8.50	24.14	110,000	190,300	7,880
59 28	do	do						3.90	2.80	8.57	24.00	66,000	213,600	8,900
59 29	do	do						3.92	2.96	8.62	25.52	84,000	190,700	7,470
60 1	Asheville Brick and Tile Co., Asheville, N. C.	"Biltmore," buff-colored brick.	5 7.75	6 7.00	15.25	17.4	30.2	2.50	4.16	8.40	34.94	51,000	110,000	3,150
60 2	do	do						2.58	4.12	8.47	34.90	44,800	110,400	3,160
60 3	do	do						2.55	4.11	8.39	34.48	57,000	141,200	4,100
60 4	do	do						2.63	4.16	8.45	35.15	36,000	108,900	3,100
60 5	do	do						2.66	4.10	8.43	34.56	48,400	116,200	3,360
60 6	do	do						2.50	4.11	8.36	34.36	72,000	156,300	4,550
60 7	do	do						2.50	4.08	8.32	33.94	68,000	121,000	3,570
61 1	North Carolina	Common, light-red, end cut brick	5 8.50	6 1.75	9.25	10.5	20.0	2.45	4.08	8.02	32.72	59,000	108,500	3,320
61 2	do	do						2.48	4.14	8.06	33.37	76,000	132,300	3,960
61 3	do	do						2.45	4.10	8.08	33.13	48,600	123,800	3,740
61 4	do	do						2.44	4.09	8.12	33.21	58,000	120,400	3,630
61 5	Asheville Brick and Tile Co., Asheville, N. C.	Common, red brick	4 9.75	5 4.00	10.25	13.9	25.8	2.29	3.77	7.95	29.97	44,000	141,000	4,700
61 6	do	do						2.27	3.69	8.00	29.52	88,000	220,000	7,450
61 7	do	do						2.35	3.82	8.30	31.71	73,000	150,600	4,750
61 8	do	do						2.30	3.75	8.06	30.23	61,000	167,000	5,520
61 9	do	do						2.35	3.75	8.19	30.71	82,000	162,100	5,280
61 10	do	do						2.35	3.81	8.20	31.24	61,800	149,900	4,800
61 11	do	do						2.32	3.78	8.19	30.96	54,000	144,000	4,650
62 1	Cronly Ceramic Co., North Carolina.	Red, face brick	4 13.00	5 6.50	9.50	12.3	23.6	2.32	3.79	7.92	30.02	76,000	203,200	6,770
62 2	do	do						2.29	3.77	7.90	29.78	92,000	187,800	6,310
62 3	do	do						2.30	3.76	7.85	29.52	49,600	243,000	8,230

62 4	.....do	.....do								2.36	3.78	7.93	29.98	92,000	206,000	6,870
62 5	.....do	.....do								2.31	3.80	7.98	30.32	101,000	234,000	7,720
62 6	.....do	.....do								2.36	3.77	7.90	29.78	91,000	194,000	6,510
62 7	.....do	.....do								2.35	3.78	7.98	30.16	108,000	213,000	7,060
63 1	.....do	"C C C" red, face brick	4	10.00	5	1.25	7.25	9.9	19.0	2.25	3.72	7.89	29.35	128,000	186,800	6,360
63 2	.....do	.....do								2.25	3.72	7.90	29.39	35,000	109,000	3,710
63 3	.....do	.....do								2.23	3.66	7.82	28.62	88,000	141,000	4,930
63 4	.....do	.....do								2.22	3.68	7.83	28.81	53,000	146,000	5,070
64 1	Asheville Brick and Tile Co., Asheville, N. C.	Dark buff-colored sidewalk brick.	6	0.	6	7.25	7.25	7.6	15.0	2.28	4.16	8.80	36.61	141,000	342,000	9,340
64 2	.....do	.....do	6	1.00	6	7.00	6.00	6.2	12.5	2.27	4.21	8.71	36.67	146,000	316,000	8,620
64 4	.....do	.....do								2.23	4.11	8.65	35.55	125,000	366,000	10,300
64 5	.....do	.....do								2.24	4.20	8.82	37.04	196,000	373,800	10,090
64 6	.....do	.....do								2.27	4.27	8.70	37.15	73,000	332,000	8,940
64 7	.....do	.....do								2.26	4.21	8.72	36.71	101,000	421,000	11,470
65 1	Caraleigh Brick Co., Raleigh, N. C.	Rough, red brick	4	6.75	5	2.75	12.0	17.0	27.3	2.50	3.80	8.00	30.40	80,200	80,200	2,640
65 2	.....do	.....do								2.49	3.78	8.04	30.39	71,000	75,000	2,470
65 3	.....do	.....do								2.50	3.71	7.95	29.49	121,000	135,200	4,580
66 4	.....do	.....do								2.52	3.78	8.08	30.54	73,000	74,200	2,430
66 5	.....do	.....do								2.51	3.81	8.00	30.48	77,400	78,100	2,560
65 6	.....do	.....do	4	6.25	5	3.25	13.0	18.5	29.8	2.53	3.73	8.00	29.84	76,000	76,000	2,550
65 7	.....do	.....do								2.50	3.70	7.93	29.34	68,000	104,300	3,550
65 8	.....do	.....do								2.53	3.76	8.02	30.16	106,000	106,000	3,510
65 9	.....do	.....do								2.53	3.76	8.02	30.16	87,800	87,800	2,910
65 10	.....do	.....do								2.52	3.76	8.02	30.16	78,000	108,800	3,610
66 1	J. A. Trollinger, Haw River, Alamana County, N. C.	Rough, dark-red brick	5	11.25	6	8.50	13.25	14.5	26.1	2.43	4.26	8.48	36.12	69,000	113,000	3,130
66 3	.....do	.....do								2.42	4.26	8.46	36.04	102,800	107,800	2,990
66 3	.....do	.....do								2.44	4.23	8.46	35.79	47,000	73,600	2,060
66 4	.....do	.....do								2.43	4.27	8.49	36.25	128,600	128,600	3,550
66 5	.....do	.....do								2.44	4.25	8.46	35.96	132,000	138,600	3,850
66 6	.....do	.....do	5	11.75	6	9.25	13.50	14.7	26.4	2.42	4.27	8.56	36.55	113,000	116,000	3,170
66 7	.....do	.....do								2.40	4.20	8.44	35.45	145,800	148,000	4,170
66 8	.....do	.....do								2.41	4.25	8.50	36.13	127,000	147,500	4,080
66 9	.....do	.....do								2.41	4.22	8.44	35.62	50,000	113,200	3,180
66 10	.....do	.....do								2.45	4.26	8.48	36.12	102,000	115,300	3,190
67 1	Hydraulic White Brick Co., Wilmington, N. C.	Light gray, sand-lime brick	5	1.50	5	12.25	10.75	13.2	24.4	2.07	4.30	8.55	36.77	179,000	194,000	5,280
67 2	.....do	.....do								2.06	4.30	8.55	36.77	125,000	143,000	3,890
67 3	.....do	.....do								2.08	4.30	8.55	36.77	177,400	198,000	5,380
67 4	.....do	.....do								2.10	4.30	8.55	36.77	193,000	214,600	5,840

BRICKS—Continued.

TESTS OF MATERIAL COLLECTED AT THE LOUISIANA PURCHASE EXPOSITION, ST. LOUIS, MO., 1904—Continued.

Marks.	From—	Description.	Weight.		Absorption.			Dimensions.			Sectional area.	First crack.	Compressive strength.	
			Dry.	Wet.	Total.	By weight.	By volume.	Height.	Compressed surface.				Total.	Per square inch.
			Lbs. oz.	*Lbs. oz.*	*Oz.*	*Per ct.*	*Per ct.*	*In.*	*In.*	*In.*	*Sq. in.*	*Pounds.*	*Pounds.*	*Lbs.*
68 1	Montgomery Land Co., Yazoo City, Miss.	Red, face brick	4 14.25	5 12.25	14.00	17.9	30.7	2.33	4.01	8.44	33.84	240,000	264,000	7,800
68 2	.....do	.....do						2.33	4.09	8.49	34.72	209,000	264,000	7,600
69 1	—— Kessler, Helena, Mont	"Kessler, Helena. Mont." red, face brick.	5 9.75	6 8.75	15.00	16.7	29.1	2.64	4.09	8.25	33.74	145,000	348,000	10,310
69 2	.....do	.....do						2.64	4.06	8.24	33.45	172,000	325,000	9,720
69 3	.....do	.....do						2.65	4.10	8.28	33.95	261,000	345,000	10,160
69 4	.....do	.....do						2.72	4.12	8.29	34.15	246,000	304,600	8,920
69 5	.....do	.....do						2.67	4.10	8.29	33.99	297,000	305,000	8,970
69 6	.....do	.....do						2.72	4.11	8.30	34.11	256,000	306,400	8,980
70 1	The McCroskey Mining and Manufacturing Co., Knoxville, Tenn.	Red-colored, face brick	4 14.50	5 8.00	9.50	12.1	23.1	2.26	3.90	8.07	31.47	218,000	229,000	7,280
70 2	.....do	Buff-colored, face brick	5 10.00	6 5.75	11.75	13.1	24.5	2.46	4.07	8.29	33.74	58,000	155,800	4,620
70 3	.....do	.....do	5 12.50	6 8.50	12.00	13.0	24.6	2.46	4.11	8.35	34.32	138,000	169,900	4,950
70 4	.....do	.....do	5 5.25	6 2.75	13.50	15.8	29.0	2.30	4.14	8.46	35.02	89,000	168,800	4,820
70 5	.....do	.....do	5 9.50	5 13.25	3.75	4.2	9.0	2.28	3.95	8.00	31.60	166,000	404,000	12,780
70 6	.....do	.....do	5 11.75	6 7.50	11.75	12.8	24.6	2.21	4.33	8.65	37.45	120,000	277,000	7,400

Sand-lime Bricks furnished by the National Association of Manufacturers of Sand-Lime Products, Wilmington, Del.

Light gray color.
(From lot used in manufacture of piers Nos. 1708, 1709, and 1710.)

Marks.	Dimensions.			Sectional area.	First crack.	Compressive strength.	
	Height.	Compressed surface.				Total.	Per square inch.
	Inches.	*Inches.*	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*
I	2.31	4.02	8.30	33.37	144,600	144,600	4,330
II	2.33	4.02	8.30	33.37	150,300	150,300	4,500
III	2.30	4.01	8.30	33.28	106,500	106,500	3,200

Compression Tests of Sand-lime Half-bricks.

Material received from the quartermaster, West Point, N. Y.
Bricks made by the Sandstone Brick Company, Schenectady, N. Y.

Marks.	Dimensions.			Sectional area.	First crack.	Compressive strength.	
	Height.	Compressed surfaces.				Total.	Per square inch.
	Inches.	*Inches.*	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*
1	2.30	4.02	4.07	16.36	51,000	56,400	3,450
2	2.30	4.01	4.39	17.60	34,000	36,200	2,060
3	2.32	4.00	4.17	16.68	29,000	46,300	2,780
4	2.30	4.01	3.65	14.64	27,100	27,100	1,850

Compression Tests of Manufactured Stone and Bricks.

Material received from the quartermaster, West Point, N. Y.

Marks.	Description.
1	Whitman manufactured "stone." Age, 10 months.
2	Whitman manufactured "stone." Age, 8 years.
3	New England manufactured "stone."
4	Economy manufactured "stone."
5	Soft shale brick.
6	Shale brick.

Compression Tests.

Marks.	Dimensions.			Sectional area.	First crack.	Compressive strength.	
	Height.	Compressed surfaces.				Total.	Per square inch.
	Inches.	*Inches.*	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*
1	2.07	3.51	3.90	13.69	44,700	44,700	3,270
2	2.13	2.78	3.80	10.56	35,200	35,200	3,330
3	2.69	3.38	4.02	13.59	34,900	34,900	2,570
4	3.88	5.11	8.93	45.63	154,500	154,500	3,390
5	2.39	3.89	8.46	32.91	75,000	132,400	4,020
6	2.29	3.75	8.28	31.05	280,000	331,000	10,660

CONCRETE, MISCELLANEOUS.

Description of Concrete Furnished by the Engineer Commissioner of the District of Columbia.

The cubes are all made of concrete in the proportions of one part Dragon Portland cement, two parts of Potomac River sand, and four and one-half parts broken diorite rock. The sand is sharp, containing quite a large proportion of fine grains and about 8 per cent by volume of silt. The broken stone is hard and of excellent quality, the fractures being sharp and angular. The run-of-crusher is used, containing about 13 per cent by volume of dust, from ¼-inch down. Quantities are measured loose by bulk and the concrete is all machine-mixed. The concrete in the blocks marked "B," however, was turned over four times with shovels after being delivered on the work from the bucket in order to test the mixing qualities of the mixer.

The blocks, numbered from 51 to 73, inclusive, were mixed very wet, and were taken from batches intended for making artificial block, which do not permit of much ramming and must necessarily have a great deal of water. The forms were removed from the cubes about 24 hours after being cast. The cubes were then covered with burlap and kept covered with water for a week, when they were exposed to the elements.

COMPRESSION TESTS OF CONCRETE CUBES FOR THE ENGINEER COMMISSIONER OF THE DISTRICT OF COLUMBIA, WASHINGTON, D. C.

Compressed surfaces faced with plaster of Paris.

Marks.	Age.	Weight.		Dimensions.			Sectional area.	First crack.	Compressive strength.	
		Total.	Per cubic feet.	Height.	Compressed surface.				Total.	Per square inch.
	Mos. days.	*Pounds.*	*Pounds.*	*Inches.*	*Inches.*	*Inches.*	*Sq. in.*	*Pounds.*	*Pounds.*	*Pounds.*
1—June 2, concrete, 10 a. m.	1 17			12.06	12.03	11.86	142.68	215,000	282,000	1,980
2—June 2, concrete, 11 a. m.	1 17			12.21	12.02	11.87	142.68	368,000	372,000	2,610
3—June 2, facing, 11 a. m.	1 17			12.15	11.98	11.87	142.20	291,000	291,000	2,050
4—June 4, concrete, 9 a. m.	1 15			12.30	11.98	11.92	142.80	254,800	276,200	1,930
5—June 4, facing, 9 a. m.	1 15			12.14	11.95	11.93	142.50	253,000	253,000	1,770
6—June 4, facing, 1 p. m.	1 15			12.15	11.99	11.96	143.40	203,000	203,000	1,420
7—June 28, facing, 1 p. m.	1 15			12.07	11.90	11.99	[a] 136.21	168,400	168,400	1,240
8—June 28, facing, 3 p. m.	1 15			12.15	12.03	11.90	143.16	242,800	242,800	1,700
9—June 28, concrete, 3 p. m.	1 15			12.25	11.91	11.96	142.44	262,000	273,000	1,920
10—June 30, facing, 10 a. m.	1 13			12.16	11.90	12.03	143.16	190,200	190,200	1,330
11—June 30, concrete, 11 a. m.	1 13			12.26	11.78	12.02	141.60	237,100	237,100	1,670
12—June 30, concrete, 2 p. m.	1 13			12.27	11.93	11.92	142.21	150,600	155,000	1,090
13A—Concrete machine, Aug. 3.	1 27			12.23	11.90	11.97	142.44	295,000	306,800	2,150
13B—Concrete machine, Aug. 3.	1 27			12.25	12.02	11.93	143.40	311,000	329,000	2,290
13C—Concrete machine, Aug. 3.	1 27			12.38	11.85	12.02	142.44	282,000	292,000	2,050
14A—Concrete machine, Aug. 4.	1 26			12.17	12.00	11.90	142.80	298,000	321,000	2,250
14B—Concrete machine, Aug. 4.	1 26			12.40	12.04	11.89	143.16	267,000	274,500	1,920
14C—Concrete machine, Aug. 4.	1 26			12.25	11.92	11.94	142.32	298,000	307,400	2,160
15A—Concrete machine, Aug. 6.	1 24			12.29	11.84	12.03	142.44	239,000	241,500	1,700
15B—Concrete machine, Aug. 6.	1 24			12.28	12.02	11.87	142.68	342,000	359,000	2,520
15C—Concrete machine, Aug. 6.	1 24			12.27	11.87	12.00	142.44	329,000	329,000	2,310
16A—Concrete machine, Aug. 9.	1 21			12.28	11.89	12.01	142.80	249,000	266,000	1,860
16B—Concrete machine, Aug. 9.	1 21			12.29	11.98	11.97	143.40	251,000	263,000	1,830
16C—Concrete machine, Aug. 9.	1 21			12.24	11.97	11.89	142.32	249,900	249,900	1,760
17—Concrete hand, Aug. 12.	1 18			12.24	11.95	11.98	143,16	258,000	264,000	1,840
18A—Concrete hand, Aug. 12.	1 18			12.28	11.87	11.99	142.32	269,000	279,800	1,970
18B—Concrete hand, Aug. 12.	1 18			12.28	11.90	12.00	142.80	236,000	240,500	1,680
19A—Concrete machine, Aug. 15.	1 15			12.33	11.95	11.99	143.28	191,000	264,000	1,840
19B—Concrete machine, Aug. 15.	1 15			12.12	12.06	11.90	143.51	215,000	258,600	1,800
19C—Concrete machine, Aug. 15.	1 15			12.15	11.89	11.96	142.20	258,000	294,000	2,070
20A—Concrete machine, Aug. 17.	1 13			12.21	11.95	11.96	142.92	304,000	315,000	2,200
20B—Concrete machine, Aug. 17.	1 13			12.19	12.05	11.92	143.64	299,000	341,000	2,370

20C—Concrete machine, Aug. 17	1	13			12.38	11.86	12.02	142.56	218,000	277,500	1,950
21A—Concrete hand, Aug. 18	1	12			12.21	12.00	11.88	142.56	216,000	234,000	1,640
21B—Concrete hand, Aug. 18	1	12			12.36	11.98	11.90	142.56	194,000	194,000	1,360
21C—Concrete hand, Aug. 18	1	12			12.19	11.81	12.03	142.07	201,000	211,000	1,490
47A—Machine, Feb. 15	2	0	132.00	127.05	12.02	11.90	12.55	149.35	85,000	91,100	610
47B—Machine, Feb. 15	2	0	130.50	131.29	11.86	12.00	12.07	144.84	97,000	104,200	719
47C—Machine, Feb. 15	2	0	123.00	125.13	11.92	11.88	12.00	142.56	82,000	86,500	607
47D—Machine, Feb. 15	2	0	129.75	131.59	12.01	11.76	12.06	141.83	125,000	125,000	881
47E—Machine, Feb. 15	2	0	130.25	130.51	12.04	11.96	11.98	143.28	121,000	121,000	844
48A—Hand mix, Feb. 18	1	27	133.50	134.44	12.07	11.84	12.01	142.20	149,600	149,600	1,050
48B—Hand mix, Feb. 18	1	27	137.25	137.80	12.20	12.00	11.76	141.12	169,200	169,200	1,200
48C—Hand mix, Feb. 18	1	27	135.25	135.93	12.07	11.72	12.16	152.52	158,500	158,500	1,110
48D—Hand mix, Feb. 18	1	27	135.25	136.07	12.00	11.73	12.20	143.11	164,900	164,900	1,150
48E—Hand mix, Feb. 18	1	27	138.50	136.45	11.98	12.00	12.20	146.40	172,000	172,000	1,170
48F—Hand mix, Feb. 18	1	27	138.75	136.70	11.88	11.98	12.32	147.59	176,000	176,000	1,190
49A—Machine, Feb. 24	1	21	142.00	143.15	11.84	11.87	12.20	144.81	144,000	179,000	1,240
49B—Machine, Feb. 24	1	21	144.75	144.89	11.91	12.08	12.00	144.96	153,000	163,000	1,120
49C—Machine, Feb. 24	1	21	145.75	144.16	11.97	12.00	12.16	145.92	173,000	179,800	1,230
49D—Machine, Feb. 24	1	21	143.50	145.98	11.95	11.90	11.94	142.09	175,000	182,600	1,290
49E—Machine, Feb. 24	1	21	142.75	146.11	12.08	11.71	11.93	139.70	162,800	171,000	1,220
49F—Machine, Feb. 24	1	21	141.50	144.09	12.05	11.74	12.00	140.88	149,000	153,000	1,090
50A—Machine, Mar. 2	1	13	136.25	137.90	11.95	11.90	12.00	142.80	200,100	200,100	1,400
50B—Machine, Mar. 2	1	13	138.00	139.68	11.90	11.95	12.00	143.40	185,000	185,000	1,290
50C—Machine, Mar. 2	1	13	134.75	137.22	11.76	12.01	12.02	144.36	154,000	154,000	1,070
50D—Machine, Mar. 2	1	13	132.75	137.00	12.05	11.40	12.19	138.97	174,300	174,300	1,250
50E—Machine, Mar. 2	1	13	132.00	137.07	12.11	11.65	11.80	137.47	163,000	163,000	1,190
50F—Machine, Mar. 2	1	13	132.00	136.08	11.89	12.05	11.70	140.99	152,800	152,800	1,080
51—Apr. 29, 1905, 5 p. m	2	7	144.75	145.8	11.97	11.90	12.04	143.28	255,200	255,200	1,780
52—May 2, 1905, 10 a. m	2	4	148.75	148.5	11.99	11.96	12.08	144.48	285,000	288,100	1,990
53—May 3, 1905, 11 a. m	2	3	147.50	148.7	11.98	11.88	12.04	143.04	200,500	200,500	1,400
54—May 5, 1905, 8 a. m	2	1	148.00	147.6	11.90	12.00	12.14	145.68	207,000	231,500	1,590
55—May 9, 1905, 8 a. m	1	28	142.75	143.6	11.92	12.02	11.99	144.12	190,000	191,300	1,330
56—May 11, 1905, 8 a. m	1	26	148.25	146.9	11.97	11.91	12.23	145.66	189,000	191,000	1,310
57—May 13, 1905, 11 a. m	1	24	145.75	144.0	11.91	12.02	12.21	146.76	251,000	251,000	1,710
58—May 15, 1905, 1 p. m	1	22	145.00	144.7	11.96	11.93	12.14	144.83	167,000	173,000	1,190
59—May 16, 1905, 9 a. m	1	21	148.50	146.4	11.98	11.96	12.23	146.27	281,000	281,000	1,920
60—May 17, 1905, 8 a. m	1	20	147.25	145.2	12.03	11.86	12.28	145.64	189,800	189,800	1,300
61—May 18, 1905, 3 p. m	1	19	147.75	146.0	11.96	11.95	12.23	146.15	208,900	214,000	1,460
62—May 19, 1905, 3 p. m	1	18	145.25	143.7	11.96	11.92	12.26	146.14	207,000	210,000	1,440
63—May 20, 1905, 10 a. m	2	5	148.25	146.9	12.00	11.89	12.22	145.30	254,500	254,500	1,750
64—May 22, 1905, 8 a. m	2	3	147.25	144.1	11.92	11.95	12.40	148.18	328,000	328,000	2,210
65—May 23, 1905, 3 p. m	2	2	146.25	145.4	11.90	12.01	12.16	146.04	352,500	352,500	2,410
66—May 24, 1905, 10 a. m	2	1	147.25	145.8	11.90	11.97	12.25	146.63	293,400	293,400	2,000
67—May 25, 1905, 10 a. m	2	0	149.00	146.7	12.01	11.93	12.25	146.14	260,800	260,800	1,780
72—May 26, 1905, 1 p. m	1	29	145.75	145.2	11.96	11.92	12.17	145.08	255,900	255,900	1,760
73—May 27, 1905, 9 a. m	1	28	146.75	145.0	12.00	11.92	12.23	145.78	260,200	260,200	1,780
74A—May 29, 1905, 2 p. m	1	26	144.50	143.9	11.97	12.00	12.08	144.96	277,600	277,600	1,920

[a] One corner gone, reducing sectional area 6.47 square inches.

COMPRESSION TESTS OF CONCRETE CUBES FOR THE ENGINEER COMMISSIONER OF THE DISTRICT OF COLUMBIA, WASHINGTON, D. C.—Continued.

Marks.	Age.	Weight.		Dimensions.			Sectional area.	First crack.	Compressive strength.	
		Total.	Per cubic feet.	Height.	Compressed surface.				Total.	Per square inch.
	Mos. days.	*Pounds.*	*Pounds.*	*Inches.*	*Inches.*	*Inches.*	*Sq. in.*	*Pounds.*	*Pounds.*	*Pounds.*
74B—May 29, 1905, 2 p. m.	1 26	147.00	144.7	11.90	12.01	12.28	147.48	267,000	267,000	1,810
75A—May 30, 1905, 1 p. m.	1 25	151.75	149.7	12.01	11.92	12.24	145.90	467,000	478,000	3,280
75B—May 30, 1905, 1 p. m.	1 25	152.75	149.9	11.93	11.94	12.36	147.58	385,000	392,000	2,660
76A—May 30, 1905, 2 p. m.	1 25	154.00	149.7	12.00	12.37	11.98	148.19	377,000	377,000	2,540
76B—May 30, 1905, 2 p. m.	1 25	150.25	150.9	12.00	11.80	12.15	143.37	398,500	398,500	2,780
77A—May 31, 1905, 2 p. m.	1 25	148.50	146.9	11.88	12.00	12.26	147.12	326,000	331,000	2,250
77B—May 31, 1905, 2 p. m.	1 25	150.00	148.8	11.86	11.99	12.25	146.88	349,000	350,200	2,380
78A—May 31, 1905, 3 p. m.	1 25	148.75	149.6	11.97	11.79	12.17	143.48	310,400	310,400	2,160
78B—May 31, 1905, 3 p. m.	1 25	149.75	150.4	12.08	11.90	11.97	142.45	306,000	311,400	2,190
79A—June 1, 1905, 1 p. m.	1 24	148.00	146.2	11.88	12.00	12.27	147.24	328,000	328,000	2,230
79B—June 1, 1905, 1 p. m.	1 24	149.75	147.8	11.96	11.94	12.26	146.38	321,000	321,000	2,190
80A—June 1, 1905, 2 p. m.	1 24	145.00	144.1	12.05	11.80	12.23	144.31	248,000	248,000	1,720
80B—June 1, 1905, 2 p. m.	1 24	145.75	144.4	11.89	12.00	12.22	146.64	286,000	286,000	1,950
81A—June 2, 1905, 11 a. m.	1 23	149.25	148.4	12.07	11.81	12.20	144.08	314,000	314,000	2,180
81B—June 2, 1905, 11 a. m.	1 23	148.75	145.3	11.90	12.00	12.39	148.68	304,000	306,000	2,060
82A—June 2, 1905, 2 p. m.	2 9	149.00	149.0	11.93	11.92	12.16	144.95	324,500	324,500	2,240
82B—June 2, 1905, 2 p. m.	2 9	151.00	150.7	11.94	11.93	12.16	145.07	332,800	333,800	2,300
83A—June 6, 1905, 9 a. m.	1 25	147.00	145.5	11.97	11.90	12.25	145.78	302,000	302,000	2,070
83B—June 6, 1905, 9 a. m.	1 25	148.00	146.7	11.90	12.03	12.18	146.53	339,400	339,400	2,320
84A—June 6, 1905, 1 p. m.	1 25	147.00	144.1	11.91	12.03	12.30	147.97	329,900	329,900	2,230
84B—June 6, 1905, 1 p. m.	1 25	145.00	139.4	12.14	11.86	12.18	144.45	320,500	320,500	2,220
85A—June 8, 1905, 10 a. m.	1 23	152.50	152.0	11.96	11.90	12.18	144.94	435,000	435,000	3,000
85B—June 8, 1905, 10 a. m.	1 23	155.00	152.7	11.95	11.96	12.27	146.75	369,000	406,000	2,770
86A—June 8, 1905, 2 p. m.	1 23	146.25	144.4	12.01	11.88	12.27	145.77	329,200	329,200	2,260
86B—June 8, 1905, 2 p. m.	1 23	148.00	147.4	12.07	11.82	12.16	143.73	339,000	339,000	2,360
87A—June 9, 1905, 3 p. m.	1 22	149.75	148.9	11.88	11.99	12.20	146.28	391,000	391,000	2,670
87B—June 9, 1905, 3 p. m.	1 22	151.50	148.8	11.87	12.03	12.32	148.21	419,500	419,500	2,830
88A—June 9, 1905, 4 p. m.	1 22	150.75	147.9	11.93	12.00	12.30	147.60	394,000	397,500	2,690
88B—June 9, 1905, 4 p. m.	1 22	147.25	146.7	11.98	11.87	12.20	144.81	346,000	346,000	2,390
89A—June 10, 1905, 11 a. m.	1 20	149.25	147.8	11.84	12.02	12.26	147.37	310,200	310,200	2,100
89B—June 10, 1905, 11 a. m.	1 20	150.25	147.4	11.86	11.98	12.39	148.43	341,500	341,500	2,300
90A—June 10, 1905, 3 p. m.	1 20	152.00	149.3	11.98	11.96	12.28	146.87	399,800	399,800	2,720
90B—June 10, 1905, 3 p. m.	1 20	147.25	146.2	11.91	11.98	12.19	146.04	359,700	359,700	2,460
91A—June 13, 1905, 10 a. m.	1 18	152.25	191.3	12.04	11.86	12.34	146.35	402,000	405,000	2,770
91B—June 13, 1905, 10 a. m.	1 18	154.75	151.0	12.00	11.79	12.52	147.61	394,000	441,000	2,990

92A—June 13, 1905, 2 p. m.	1	18	149.25	149.0	11.88	11.98	12.16	145.68	323,000	323,000	2,220
92B—June 13, 1905, 2 p. m.	1	18	149.75	147.8	11.82	12.06	12.28	148.10	298,400	298,400	2,010
93A—June 15, 1905, 9 a. m.	1	16	147.75	139.7	11.99	11.80	12.92	152.46	305,500	305,500	2,000
93B—June 15, 1905, 9 a. m.	1	16	147.75	146.0	12.06	11.82	12.27	145.03	279,200	279,200	1,930
94A—June 15, 1905 11 a. m.	2	24	152.00	148.0	12.02	11.86	12.45	147.65	354,000	354,000	2,398
94B—June 15, 1905, 11 a. m.	2	24	146.50	145.7	11.95	11.90	12.22	145.42	322,000	322,000	[a] 2,214
95A—June 16, 1905, 12 m.	2	23	153.25	149.6	11.83	12.00	12.47	149.64	429,000	452,000	[a] 3,021
95B—June 16, 1905, 12 m.	2	23	154.00	150.8	12.01	11.85	12.40	146.94	490,000	521,000	3,546
96A—June 16, 1905, 2 p. m.	2	23	151.00	149.5	11.95	12.02	12.15	146.04	420,000	429,500	[a] 2,941
96B—June 16, 1905, 2 p. m.	2	23	147.25	146.3	11.95	11.90	12.23	145.54	426,000	426,000	2,927
99A—June 27, 1905, 11 a. m.	2	12	150.75	149.3	11.83	12.01	12.28	147.48	354,000	354,000	2,400
99B—June 27, 1905, 11 a. m.	2	12	149.00	147.8	12.00	11.80	12.30	145.14	317,000	317,000	2,184
100A—June 27, 1905, 2 p. m.	2	12	152.50	149.5	11.94	12.00	12.30	147.60	341,000	345,000	2,337
100B—June 27, 1905, 2 p. m.	2	12	149.00	148.2	11.92	11.93	12.22	145.78	401,000	401,000	2,751
101A—June 28, 1905, 4 p. m.	2	11	154.50	151.1	11.88	12.02	12.37	148.69	313,500	313,500	[a] 2,109
101B—June 28, 1905, 4 p. m.	2	11	154.25	148.5	11.90	12.07	12.50	150.88	341,000	346,000	2,293
102A—June 28, 1905, 5 p. m.	2	11	147.50	147.0	11.92	11.97	12.15	145.44	341,000	341,000	[a] 2,345
102B—June 28, 1905, 5 p. m.	2	11	148.00	145.8	11.93	11.95	12.30	146.99	340,500	340,500	[a] 2,316
103A—June 29, 1905, 5 p. m.	2	10	147.50	145.9	12.06	11.91	12.16	144.83	340,000	340,000	2,348
103B—June 29, 1905, 5 p. m.	2	10	148.25	145.8	11.85	12.03	12.32	148.21	362,000	362,000	2,442
104A—June 30, 1905, 10 a. m.	2	9	146.00	146.2	11.91	11.94	12.13	144.83	342,000	342,000	2,361
104B—June 30, 1905, 10 a. m.	2	9	150.50	148.6	12.02	11.89	12.25	145.65	326,000	326,000	2,238
105A—June 30, 1905, 12 m.	2	9	147.00	146.5	12.05	11.85	12.14	143.86	291,000	291,000	2,023
105B—June 30, 1905, 12 m.	2	9	146.50	146.7	12.00	11.73	12.26	143.81	299,900	299,900	2,085
106A—July 7, 1905, 11 a. m.	2	2	154.75	148.8	11.85	12.27	12.36	151.66	387,000	387,000	2,552
106B—July 7, 1905, 11 a. m.	2	2	151.50	148.9	12.06	11.85	12.30	145.76	348,000	348,000	2,387
107A—July 7, 1905, 4 p. m.	2	2	148.50	148.2	11.93	11.90	12.20	145.18	327,000	327,000	2,252
107B—July 7, 1905, 4 p. m.	2	2	148.75	147.9	11.90	11.99	12.18	146.04	340,500	340,500	2,332
108A—July 11, 1905, 9 a. m.	1	28	147.75	144.3	11.95	11.98	12.36	148.07	274,000	274,000	1,850
108B—July 11, 1905, 9 a. m.	1	28	147.25	145.3	11.95	11.90	12.31	146.49	299,000	299,000	2,041
109A—July 11, 1905, 3 p. m.	1	28	151.50	149.2	11.81	12.15	12.23	148.59	286,000	286,000	1,925
109B—July 11, 1905, 3 p. m.	1	28	150.75	147.0	11.93	12.02	12.36	148.57	296,500	296,500	1,996
110A—July 12, 1905, 4 p. m.	1	27	148.25	147.5	12.01	11.85	12.20	144.57	298,000	299,400	[a] 2,071
110B—July 12, 1905, 4 p. m.	1	27	150.50	149.3	11.91	11.98	12.21	146.28	288,400	288,400	[a] 1,972
111A—July 14, 1905, 9 a. m.	1	25	152.00	148.6	11.88	11.98	12.42	148.79	306,000	307,500	2,067
111B—July 14, 1905, 9 a. m.	1	25	150.25	146.9	12.06	11.79	12.43	146.55	294,000	294,000	2,006
112A—July 15, 1905.	1	24	147.50	146.1	12.06	11.88	12.18	144.70	196,000	196,000	1,355
112B—July 15, 1905.	1	24	145.25	146.1	11.93	11.89	12.11	143.99	193,600	193,600	1,345
113A—July 17, 1905.	1	22	152.75	150.9	12.10	11.80	12.25	144.55	282,000	282,000	1,951
113B—July 17, 1905.	1	22	153.00	149.1	11.98	11.90	12.43	147.93	294,000	294,000	1,988
114A—July 17, 1905, 11 a. m.	1	22	149.25	148.1	11.88	11.97	12.25	146.63	253,500	253,500	1,729
114B—July 17, 1905, 11 a. m.	1	22	148.25	146.8	11.97	11.93	12.22	145.78	253,400	253,400	1,738
115A—July 17, 1905, 4 p. m.	1	22	148.50	146.0	11.88	12.06	12.27	147.98	275,800	275,800	1,864
115B—July 17, 1905, 4 p. m.	1	22	148.75	150.1	12.02	11.86	12 01	142.44	239,000	239,000	1,678
116A—July 19, 1905, 9 a. m.	1	20	148.00	146.8	12.03	11.85	12.22	144.81	218,000	218,000	1,506
116B—July 19, 1905, 9 a. m.	1	20	146.25	145.2	12.11	11.77	12.21	143.72	214,000	214,000	1,489
117A—July 19, 1905, 12 m.	1	20	146.75	144.5	11.95	11.98	12.26	146.87	254,000	254,000	[a] 1,729
117B—July 19, 1905, 12 m.	1	20	146.75	145.3	11.92	11.94	12.26	146.38	249,000	251,000	[a] 1,715
118A—July 19, 1905, 5 p. m.	1	20	142.50	143.6	12.07	11.83	12.01	142.08	219,900	219,900	[a] 1,548
118B—July 19, 1905, 5 p. m.	1	22	141.50	141.3	11.80	12.24	11.98	146.64	239,900	239,900	[a] 1,636

[a] Corner voids.

COMPRESSION TESTS OF CONCRETE CUBES FOR THE ENGINEER COMMISSIONER OF THE DISTRICT OF COLUMBIA, WASHINGTON, D. C.—Continued.

Marks.	Age.	Weight.		Dimensions.			Sectional area.	First crack.	Compressive strength.	
		Total.	Per cubic feet.	Height.	Compressed surface.				Total.	Per square inch.
	Mos. days.	*Pounds.*	*Pounds.*	*Inches.*	*Inches.*	*Inches.*	*Sq. in.*	*Pounds.*	*Pounds.*	*Pounds.*
119A—July 20, 1905, 11 a. m.	1 21	151.50	149.4	11.87	12.02	12.28	147.61	301,400	301,400	2,042
119B—July 20, 1905 11 a. m.	1 21	151.00	149.9	11.90	11.93	12.26	146.26	293,000	298,100	2,038
120A—July 20, 1905, 2 p. m.	1 21	145.00	145.5	11.90	12.02	12.04	144.72	231,000	231,000	1,596
120B—July 20, 1905, 2 p. m.	1 21	146.75	142.5	12.16	11.80	12.40	146.32	219,800	219,800	1,502
121A—July 21, 1905, 1 p. m.	1 20	149.50	149.6	12.07	11.87	12.05	143.03	261,000	261,000	1,825
121B—July 21, 1905, 1 p. m.	1 20	147.00	146.9	11.78	12.10	12.13	146.77	268,000	268,000	1,826
122A—July 21, 1905, 3 p. m.	1 20	145.00	145.1	11.89	11.99	12.20	146.28	266,300	266,300	1,821
122B—July 21, 1905, 3 p. m.	1 20	148.75	147.7	11.87	12.00	12.22	146.64	250,200	250,200	1,706
123A—July 24, 1905, 11 a. m.	1 17	147.75	146.8	11.87	12.03	12.18	146.53	214,500	214,500	1,464
123B—July 24, 1905, 11 a. m.	1 17	147.75	145.6	11.92	11.96	12.30	147.11	212,200	212,200	1,442
124A—July 24, 1905, 3 p. m.	1 17	149.00	143.8	11.81	12.33	12.30	151.66	258,400	258,400	[a] 1,703
124B—July 24, 1905, 3 p. m.	1 17	148.25	146.5	12.01	11.84	12.30	145.63	269,500	269,500	1,851
125A—July 24, 1905, 5 p. m.	1 17	147.50	145.5	11.90	12.00	12.27	147.24	199,000	203,000	1,379
125B—July 24, 1905, 5 p. m.	1 17	145.25	145.1	12.00	11.85	12.16	144.10	199,000	199,200	1,383
129				6.45	6.41	6.39	40.96	171,500	171,500	4,190
130				6.29	6.23	6.28	39.12	213,000	213,000	5,440
131				6.40	6.65	6.25	41.56	176,100	176,100	4,240
132				6.36	6.37	6.30	40.13	135,800	135,800	3,380
133				6.38	6.36	6.37	40.51	159,500	159,500	3,940
134				6.30	6.31	6.20	39.12	109,800	109,800	2,810

[a] Corner voids.

COMPRESSION TESTS OF CEMENT MORTAR, AND CONCRETE CUBES FOR U. S. ENGINEER CORPS.

CUBES SENT FROM LOCK No. 11, KENTUCKY RIVER.

Compressed surfaces faced with plaster of paris.

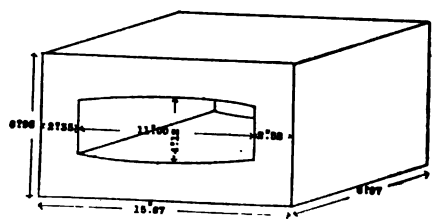
Marks.	Composition.			Age.	Dimensions.			Sectional area.	First crack.	Compressive strength.	
	Cement.	Sand.	Stone.		Height.	Compressed surface.				Total.	Per square inch.
				Days.	*Inches.*	*Inches.*	*Inches.*	*Sq. ins.*	*Lbs.*	*Lbs.*	*Lbs.*
1	1	3	.....	25	2.04	1.98	1.99	3.94	5,960	5,960	1,510
2	1	3	.....	25	2.03	2.01	1.98	3.98	6,800	6,800	1,710
3	1	3	.....	25	2.00	2.00	1.96	3.92	7,350	7,350	1,880
4	1	3	.....	25	1.96	1.98	1.97	3.90	4,910	4,910	1,260
5	1	3	.....	24	2.00	2.00	2.00	4.00	9,100	9,100	2,280
6	1	3	.....	24	2.01	2.01	1.96	3.94	8,820	8,820	2,240
7	1	3	.....	24	2.02	2.02	1.94	3.92	9,100	9,100	2,320
8	1	3	.....	24	2.02	2.00	1.98	3.96	5,500	5,500	2,150
9	1	3	6	22	2.06	2.02	1.98	4.00	5,560	5,560	1,390
10	1	3	6	22	2.06	2.03	1.98	4.02	3,940	3,940	980
11	1	3	.....	22	2.01	2.00	1.94	3.88	5,100	5,100	1,310
12	1	3	.....	22	2.04	1.95	1.99	3.88	5,480	5,480	1,410

COMPRESSION TESTS OF CONCRETE BUILDING BLOCKS FURNISHED BY THE HAYDEN AUTOMATIC BLOCK MACHINE COMPANY, COLUMBUS, OHIO.

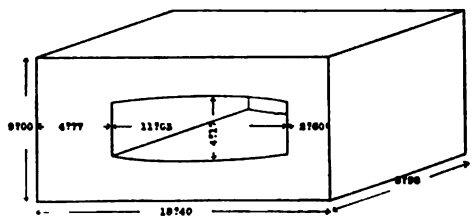
Blocks said to be: Facing, one-third cement; backing, one-fifth cement. Lake Erie sand used.

Age, 8 months.

ROCK FACE BLOCK.



Net sectional area, 101.70 square inches.
Compressive strength, total, 238,500 pounds.
Compressive strength, per square inch, 2,350 pounds.



Net sectional area, 124.40 square inches.
Compressive strength, total, 364,000 pounds.
Compressive strength, per square inch, 2,930 pounds.

STONE, MISCELLANEOUS.

COMPRESSION TEST OF ROCK CUBE FROM DAM SITE, ROOSEVELT, ARIZ.

[Received from U. S. Geological Survey.]

Dimensions of specimen, 2″ by 2″ by 2″.
Sectional area, 4 square inches.

First crack	pounds..	155,000
Compressive strength, total	do....	184,800
Compressive strength, per square inch	do....	46,200

Pyramidal fracture.

CHEMICAL ANALYSIS.

Silica	27.10
Alumina	2.50
Lime	21.80
Magnesia	13.39
Carbon dioxide	35.21

SANDSTONE FROM DAWSON, IND. T.

Specimens received from Mr. J. Foucart, architect, Guthrie, Okla.

CHEMICAL ANALYSIS.

Silica	75.50
Oxide of iron	2.31
Alumina	19.59
Lime	0.90
Loss at red heat	1.70

ABSORPTION OF WATER.

	Lbs.	Ozs.
Weight, dry	4	9½
Weight, wet, after one week in water	4	14¼
Gain in weight		4¾

	Per cent.
Absorption, by weight	6.5
Absorption, by volume	13.8

COMPRESSION TESTS.

Compressed surfaces faced with plaster of Paris to secure even bearings in the testing machine.
Samples tested on bed.
Color, light drab.

Marks.	Dimensions.			Sectional area.	First crack.	Compressive strength.	
	Height.	Compressed surface.				Total.	Per square inch.
	Inches.	*Inches.*	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*
1	3.80	3.76	3.80	14.29	79,900	79,900	5,590
2	3.90	3.90	3.85	15.02	74,600	74,600	4,970

Pyramidal fractures.

COMPRESSION TEST OF RED SANDSTONE.

Sample received from the U. S. Geological Survey, Washington, D. C.

Dimensions of specimen, 1″.50 by 2″.45 by 1″.59.

Sectional area, 3.68 square inches.

First crack	pounds..	12,200
Ultimate strength, total	do....	13,100
Ultimate strength, per square inch	do....	3,560

COMPRESSION TESTS OF GRANITE CUBES.

Samples furnished by Mr. John Swenson, Concord, N. H., at the request of the U. S. Geological Survey.

Compressed surfaces faced with plaster of Paris.

Dimensions.			Sectional area.	First crack.	Compressive strength.	
Height.	Compressed surface.				Total.	Per square inch.
Inches.	*Inches.*	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*
3.08	3.06	3.07	9.39	289,500	289,500	30,830
3.03	3.06	3.07	9.39	208,000	224,000	23,860

Pyramidal fractures.

PAPER.

TENSILE TESTS OF BLUE-PRINT AND BROWN-PRINT PAPER.

Specimens received from the Ordnance Department, U. S. Army, Washington, D. C.
Length of specimens over all, 5″.
Length of specimens between jaws, 3″.
Width of specimens, 1″.

Color.	Marks.	Thickness.	Sectional area.	Tensile strength.				
				Specimen.			Mean.	
				1.	2.	3.	Total.	Per square inch.
		Inch.	*Sq. in.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Pounds.*
Blue.....	Technical Supply Co., medium satin, No. 185.	.0053	.0053	14	14	13.5	13.8	2,600
Do.....	Fred A. Schmidt, Union satin, blue process, No. 215.	.0051	.0051	28.5	29	29	28.8	5,650
Brown...	Technical Supply Co., premo sepia solar paper, No. 219.	.0026	.0026	19.5	19	20	19.5	7,500
Do.....	Fred A. Schmidt, Vandyke solar paper, No. 227½.	.0032	.0032	24	24	24	24	7,500
Do.....	Fred A. Schmidt, Vandyke solar paper, No. 229½.	.0028	.0028	20	18.5	19	19.2	6,860

PRIVATE TESTS.

Tests made for private parties during the fiscal year ended June 30, 1906.

Date.	Material.	For whom tested.	
		Name.	City and State.
1905.			
July 3	Steel bars	Boston Transit Commission	Boston, Mass.
3	Steel bars with clips	Aberthaw Construction Co	Do.
3	Steel cylinder	Merrimac Chemical Co	North Woburn, Mass.
3	Turnbuckle	Boston Transit Commission	Boston, Mass.
5	Steel bars	do	Do.
5	Wrenches	Trimont Manufacturing Co	Roxbury, Mass.
6	Steel bars with clips	Aberthaw Construction Co	Boston, Mass.
7	Building blocks	Noyes F. Palmer Manufacturing Co.	Brooklyn, N. Y.
7	Bronze and aluminum	Regenerated Cold Air Co	Boston, Mass.
14	Steel specimens	Wyman & Gordon	Worcester, Mass.
14	do	Savage Arms Co	Utica, N. Y.
18	Steel-wire rope	American Steel and Wire Co	Worcester, Mass.
26	Steel bars with clips	Aberthaw Construction Co	Boston, Mass.
29	Steel specimens	Alan Wood, Iron, and Steel Co	Conshohocken, Pa.
29	Wrought iron	Hollingsworth & Whitney	Boston, Mass.
29	Steel specimens	Colonial Steel Co	Do.
Aug. 3	Steel bars with clips	Aberthaw Construction Co	Do.
24	Granite	Woodbury Granite Co	Hardwick, Vt.
26	Steel specimens	Wyman & Gordon	Worcester, Mass.
26	do	Savage Arms Co	Utica, N. Y.
28	Steel bars	Frank B. Gilbreth	Boston, Mass.
29	do	Manganese Steel Safe Co	Plainfield, N. J.
29	Canvas belting	Sawyer Belting Co	East Cambridge, Mass.
30	do	do	Do.
30	Steel rods	Boston Transit Commission	Boston, Mass.
31	Shot lines	The Lincoln-Dillaway Co	Do.
Sept. 1	Steel-wire rope	American Steel and Wire Co	Worcester, Mass.
5	Manila rope	Easton Cordage Co	Easton, Pa.
11	Steel-wire rope	American Steel and Wire Co	Worcester, Mass.
12	Hydraulic gauges	The Ashton Valve Co	Boston, Mass.
12	Steel bars with clips	The Aberthaw Construction Co	Do.
13	Hydraulic gauges	Ashcroft Manufacturing Co	Bridgeport, Conn.
13	Canvas belting	Ruboil Belting Co	Boston, Mass.
14	Building blocks	Wm. Hurley & Co	Buffalo, N. Y.
15	do	Buffalo Concrete, Stone, and Brick Co.	Do.
16	Steel-wire rope	American Steel and Wire Co	Worcester, Mass.
16	Cement fence post	Cement Machinery Co	Jackson, Mich.
18	Steel rails	F. C. Stowell	Boston, Mass.
20	Steel bars	Jesse M. Gove	Do.
22	Cast iron	Standard Brazing Co	Do.
23	Steel specimens	Wyman & Gordon	Worcester, Mass.
26	Steel bars	Jesse M. Gove	Boston, Mass.
26	Aluminium alloy	Hood Rubber Co	Do.
27	Steel specimens	Isaac G. Johnson & Co	Spuyten Duyvil, N. Y.
28	Steel bars	Jesse M. Gove	Boston, Mass.
30	Copper wire	Holtzer-Cabot Electric Co	Brookline, Mass.
30	Steel specimens	Wyman & Gordon,	Worcester, Mass.
Oct. 3	Cast iron	Sterling Elliott	Newton, Mass.
7	Bronze specimen	Corwin Manufacturing Co	Peabody, Mass.
7	Steel specimens	Wyman & Gordon	Worcester, Mass.
13	Cast iron	Standard Brazing Co	Boston, Mass.
14	Steel specimens	Wyman & Gordon	Worcester, Mass.
16	Columns	American Column Co	Brooklyn, N. Y.
24	Steel specimens	Wyman & Gordon	Worcester, Mass.
Nov. 1	Steel bars	Charles River Basin Commission	Boston, Mass.
2	Cast iron	Farrel Foundry and Machine Co	Ansonia, Conn.
8	Brass tubing	American Tube Works	Boston, Mass.
9	do	do	Do.
9	Hollow bricks	Wm. Wirt Clark & Son	Baltimore, Md.
9	Concrete cylinder	Boston Transit Commission	Boston, Mass.
9	Granite	City of Cincinnati	Cincinnati, Ohio.
9	Concrete cubes	F. R. Upton	Orange, N. J.
9	Column bases	Lally Patent Column Co	Waltham, Mass.
9	Building blocks	C. A. Rupp Building Construction Co.	Buffalo, N. Y.
10	Concrete blocks	H. A. Carson	Boston, Mass.
10	Steel specimens	Wyman & Gordon	Worcester, Mass.
10	Wrenches	Trimont Manufacturing Co	Roxbury, Mass.
11	do	do	Do.

PRIVATE TESTS—Continued.

Date.	Material.	For whom tested.	
		Name.	City and State.
1905.			
Nov. 13	Swivel hooks	The Thomas Laughlin Co	Portland, Me.
13	Grooved steel bars	J. F. Golding	Washington, D. C.
14	Wires	do	Do.
14	Steel bolt	Montpelier and Wells River R. R.	Montpelier, Vt.
14	Malleable-iron link	Plymouth Cordage Co	North Plymouth, Mass.
20	Steel specimens	Wyman & Gordon	Worcester, Mass.
24	Cotton duck	M. H. Merriam	Boston, Mass.
24	Manila strands	Columbian Rope Co	Auburn, N. Y.
25	Rubber belting	Revere Rubber Co	Chelsea, Mass.
Dec. 1	Steel specimens	Wyman & Gordon	Worcester, Mass.
1	do	The W. H. Davenport Fire Arms Co.	Norwich, Conn.
6	Bronze	Victor Metals Co	East Braintree, Mass.
8	Steel specimens	Electric Vehicle Co	Hartford, Conn.
9	Building blocks	Hartford Concrete Block Co	Do.
9	Steel wire rope	American Steel and Wire Co	Worcester, Mass.
9	Steel specimens	Wyman & Gordon	Do.
11	do	do	Do.
12	Steel wire	General Electric Co	Schenectady, N. Y.
14	Sandstone	John Stewart	Portland, Oreg.
15	Steel specimens	The W. H. Davenport Fire Arms Co.	Norwich, Conn.
16	Steel bars	Jesse M. Gove	Boston, Mass.
28	Steel specimens	Wyman & Gordon	Worcester, Mass.
28	Cement	Pilling & Crane	Boston, Mass.
28	Brake chain	Boston and Maine R. R. Co.	Do.
1906.			
Jan. 4	Bronze	Taunton-New Bedford Copper Co.	Taunton, Mass.
6	Steel wire rope	Harold L. Bond	Boston, Mass.
9	Steel specimens	Wyman & Gordon	Worcester, Mass.
12	Bronze	Corwin Manufacturing Co	Peabody, Mass.
15	Cast iron	Farrel Foundry and Machine Co.	Ansonia, Conn.
22	Bronze	Victor Metals Co	East Braintree, Mass.
22	Wrought iron	Harrington, Robinson & Co	Boston, Mass.
23	Canvas belting	Ruboil Belting Co	Do.
24	Manila rope	Plymouth Cordage Co	North Plymouth, Mass.
25	Bricks	Waldo Brothers	Boston, Mass.
25	Marble	Brown & Cassell	Harriman, Tenn.
25	Building blocks	J. A. Gibson	Buffalo, N. Y.
29	Wrought iron	Harrington, Robinson & Co	Boston, Mass.
31	Bronze	Victor Metals Co	East Braintree, Mass.
Feb. 7	Steel rivet	Boston Elevated Rwy. Co	Boston, Mass.
9	Wrought iron	The Sylvester Co	Do.
10	Bricks	The Winifrede Coal Co	Philadelphia, Pa.
17	Steel specimens	Wyman & Gordon	Worcester, Mass.
19	do	do	Do.
Mar. 1	do	Isaac G. Johnson & Co	Spuyten Duyvil, N. Y.
3	Manila rope	Plymouth Cordage Co	North Plymouth, Mass.
5	Steel	American and British Manufacturing Co.	Providence, R. I.
5	Shackles	Fletcher & Crowell Co	Portland, Me.
7	Bricks	Cement Machinery Co	Jackson, Mich.
12	Test gauge	The Ashcroft Manufacturing Co.	Bridgeport, Conn.
13	Chain	Thomson Electric Welding Co	Lynn, Mass.
17	Steel specimens	Wyman & Gordon	Worcester, Mass.
26	do	Savage Arms Co	Utica, N. Y.
26	do	American and British Manufacturing Co.	Providence, R. I.
27	Concrete prisms	H. A. Carson	Boston, Mass.
27	Roofing bracket	A. P. Henderson	Hanover, Mass.
28	Building blocks	Noyes F. Palmer Manufacturing Co.	Brooklyn, N. Y.
29	Bronze	Taunton-New Bedford Copper Co.	Taunton, Mass.
30	Concrete	H. A. Carson	Boston, Mass.
30	Chain cable	H. I. Crandall & Sons Co	East Boston, Mass.
31	Steel specimens	Wyman & Gordon	Worcester, Mass.
Apr. 2	do	do	Do.
2	do	American and British Manufacturing Co.	Providence, R. I.
5	do	Albert Ladd Colby	New York, N. Y.
6	do	American and British Manufacturing Co.	Providence, R. I.
9	Marble column	Hilgartner Marble Co	Baltimore, Md.
10	Steel specimens	American Diesel Engine Co	New York, N. Y.
14	do	Wyman & Gordon	Worcester, Mass.

PRIVATE TESTS—Continued.

Date.	Material.	For whom tested.	
		Name.	City and State.
1906.			
Apr. 14	Concrete column	Bush Terminal Co	Brooklyn, N. Y.
20	Steel specimens	Savage Arms Co	Utica, N. Y.
20	do	American and British Manufacturing Co.	Providence, R. I.
21	Bronze	B. F. Sturtevant Co	Hyde Park, Mass.
23	Net	Hood Rubber Co	East Watertown, Mass.
24	Buoy shackles	Fletcher & Crowell Co	Portland, Me.
25	Steel specimens	American and British Manufacturing Co.	Providence, R. I.
27	do	Savage Arms Co	Utica, N. Y.
May 3	do	American and British Manufacturing Co.	Providence, R. I.
3	Shackles	Fletcher & Crowell Co	Portland, Me.
8	Steel specimens	American and British Manufacturing Co.	Providence, R. I.
9	Concrete prisms	H. A. Carson	Boston, Mass.
9	Steel specimens	Wyman & Gordon	Worcester, Mass.
10	do	American and British Manufacturing Co.	Providence, R. I.
18	do	Savage Arms Co	Utica, N. Y.
18	Copper wire and joints	Holtzer-Cabot Electric Co	Brookline, Mass.
22	Steel specimens	The Wyman & Gordon Co	Worcester, Mass.
28	do	Savage Arms Co	Utica, N. Y.
28	Concrete and mortar	S. E. Thompson	Newton Highlands, Mass.
28	Steel specimens	Geo. F. Blake Manufacturing Co.	East Cambridge, Mass.
29	Wire rope sockets	J. H. Williams & Co	Brooklyn, N. Y.
29	Prison bar	State of New York	Albany, N. Y.
29	Steel plate	New England Structural Co	Everett, Mass.
June 2	do	Boston Consolidated Gas Co	Boston, Mass.
2	Iron bars	Cambridge Water Works	Cambridge, Mass.
4	Steel specimens	The Wyman & Gordon Co	Worcester, Mass.
5	do	Boston Consolidated Gas Co	Boston, Mass.
7	do	The Wyman & Gordon Co	Worcester, Mass.
8	do	American and British Manufacturing Co.	Providence, R. I.
8	do	Farrel Foundry and Machine Co.	Ansonia, Conn.
9	do	Mix & Hartel	Boston, Mass.
11	Manila rope	Columbian Rope Co	Auburn, N. Y.
11	Marble	The Traitel Marble Co	Long Island City, N. Y.
11	Concrete	The Henry Souther Engineering Co.	Hartford, Conn.
11	Building blocks	Henry Hecker	Buffalo, N. Y.
11	do	Wm. V. McCormack	Do.
12	do	do	Do.
12	do	Wisdom Paving Co	Do.
12	do	Robert Philpot	Melrose, Mass.
12	Steel specimens	Savage Arms Co	Utica, N. Y.
12	do	American Diesel Engine Co	New York, N. Y.
25	do	The Wyman & Gordon Co	Worcester, Mass.
25	Cement	Niagara Cement Co	Buffalo, N. Y.
29	Steel specimens	The Wyman & Gordon Co	Worcester, Mass.
30	do	Savage Arms Co	Utica, N. Y.
30	Hydraulic gauge	The Ashcroft Manufacturing Co.	Bridgeport, Conn.
30	Bronze	The Pennsylvania Steel Co	Steelton, Pa.

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